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1919—Canada's Year

With this issue, dated January 1, 1919, we welcome in a new year which, in point of building, construction and engineering activity, bids fair to eclipse anything that has gone before in Canadian history. The war is over and won and we are full of confidence in our own capabilities. The last four years has seen very large sums of money brought into the country and distributed among the people—much of this, directly or indirectly, is awaiting investment. Lastly, building and construction, which in 1912 and 1913 was going forward at the rate of a half billion dollars a year, has for the last five years been held greatly in abeyance.

We have the self-confidence, the money and the outlet for both. The year 1919 should be Canada's year.

Winnipeg Builders' Exchange Annual

THE annual general meeting of the Winnipeg Builders' Exchange was held on December 17, at the Fort Garry Hotel. The programme opened with a dinner at 6.30 o'clock. President H. F. Hazleton being in the chair, and amongst those in attendance were Mayor Davidson, a former president of the Exchange, and Mr. W. H. Carter, also a past-president, who is now president of the Winnipeg Board of Trade.

After the dinner a number of reports were presented, and the financial condition of the Exchange was shown to be satisfactory. It was also reported that twenty-nine new members were added during the year, the total now being 166.

Mr. Hazleton, in his presidential address told briefly how the Exchange had carried on during the past year—a rather dull one for building men—and spoke of the possibilities of the future optimistically. Addresses were also given by Mayor Davidson, Mr. Carter and Mr. W. B. Moore, secretary of the Board of Trade, and an excellent musical programme was provided.

The officers elected were as follows: H. T. Hazleton, president (re-elected); John Sutherland, first vice-president; N. W. Warren, second vice-president; T. D. Robinson, treasurer; J. W. Morley, painters' section; F. T. Foxcroft, sheet metal section; Wm. McCarthy, plasterers' section; W. Allen, cut stone section; A. J. Bonnett, general contractors, section; P. Muir, general contractors' section. Directors whose terms continue: J. H. Schumacher, 1 year; W. J. Hilton, 1 year; A. Matthews, 1 year; F. Dowse, 1 year; Jas. Mackie, 2 years; J. A. Marion, 2 years; H. H. Eager, 2 years; L. R. Barrett, 2 years; Chas. Dure, 2 years.

Soldiers' Garden Village

AN effort to attract soldiers to the land has been set in operation in East Lothian near the village of Longniddry. That location was chosen because it has a railway with connections for a nearby town and also for a summer resort and the county seat. It is on the main line from Edinburgh to London. The surrounding country is among the best agricultural districts of Scotland. It is also half a mile from the southern side of the Firth of Forth. Midway between the old village and the railway station the experimental settlement has been started. The main street branches off from the main road, forms a crescent and again returns to the road. This is the recreation ground. On the opposite side of the road is the bowling green.

The houses face on the crescent and each has a southern exposure thus insuring sunshine for the front rooms. There are three kinds of houses, all built in the same general style and differing only in size. The smallest has kitchen, scullery, bath room and living room all embodying the latest ideas as to convenience and sanitation. Hot and cold water are provided for. This style of house is intended for a childless couple. The next style has an additional living room upstairs and the third style has three living rooms, two of which are upstairs and all the rooms are considerably larger than in the other two styles.

Attached to each house is a front and back garden. In each garden there have been planted one apple tree, six gooseberry bushes, six red and six black cur-

rant bushes and several rose bushes. The original scheme provides for sixty houses. So far twenty have been erected, and are on what has been called Kitchen-Crescent. The Scottish Veterans Garden City Association before launching this experiment visited a number of garden cities and how well they have planned this one is shown by the report of the Edinburgh Trades Council which after paying an official visit pronounced the settlement far in advance of others of years' standing. The cost of erecting each house was £600 and the rent is one shilling, six pence, two shillings, two shillings six pence per week, according to size of the house.

Plainly this movement is philanthropic. Many of the houses are memorials and even parts of houses are of that character. Gayfield Cottage bears a tablet on the staircase to the effect that the cottage was erected by the staff and pupils of London Street Public School in Edinburgh "as a tribute to Scottish heroes who fell in the Great War." "Craigbinning Cottage" has a plaque on the wall with the following inscription: "In memory of Eric James Thompson, Lieutenant 7th Royal Scots, killed in action at Gallipoli on June 28, 1915." One cottage is erected to the memory of the "Warrior" (and so named) "commanded by Capt. V. B. Molteno R.N., in the battle of Jutland, May 31, 1916." "Mohawk Valley Cottage" is erected by the members of the Mohawk Valley Garden City Association, Schenectady and Amsterdam, New York. It is a memorial to Kitchener and its memorial stone was laid by his sister, Mrs. Parker. Two other cottages, "Shoreby" and "Colorado Springs Cottage" have both been built by contributions from the United States.

At about fifteen minutes' walk from the settlement is an allotment of ten acres to become, in time, chiefly a fruit farm. Already the jam factory is being remodeled. Piggeries, hen runs, bee hives are being prepared. Each man in the settlement will have his allotment here and his training. The chances for happiness to both children and adults are immense and the experiment will be watched with interest.

Life of Wooden Water Tanks in Railway Service

INTERESTING data on the life of wooden tanks were given by Mr. C. R. Knowles, Superintendent Water Service, Illinois Central R. R., in a paper presented at the last annual convention of the American Railway Bridge and Building Association, reported in Engineering and Contracting. In collecting the information letters of interest were sent to 45 railroads and 27 answers were received.

While much valuable information was obtained from the replies, the figures and estimates given as to the life of tanks were almost as many as the replies received.

The variation in the figures submitted on the life of timbers on various railroads goes to show that no accurate estimate may be made on the life of tank timber that will apply to all sections of the country. It is characteristic of timber that it is more durable when used in the region in which it is grown than when used elsewhere, for nature seems to have fortified the timber against decay to a certain extent when it is kept in its native climate.

One railroad reported 77 redwood tanks in service in California ranging from 26 to 48 years old, while another road reported redwood tanks renewed in Wisconsin after only 15 years of service. Twelve white

pine are reported in service in Michigan with an average life of 35.4 years, while it has been necessary to replace white pine tanks in Missouri after 12 to 13 years. A Texas road reports cypress tanks in service as follows:

5 tanks 31 years old,
8 tanks 30 years old,
3 tanks 29 years old,

while several eastern roads fix the minimum life of cypress at 25 years.

Table 1 shows the life of 310 tanks, 184 of which are still in service, and 126 of which have been relieved. In preparing this tabulation only figures were used where the definite life of the tank was given.

TABLE 1.
Average Life of 184 Tanks in Service.

REDWOOD	
Railroad "A" 77 tanks	Average life 32.6 years
CYPRESS.	
Railroad "B" 29 tanks	Average life 28.3 years
Railroad "C" 25 tanks	Average life 25 years
Railroad "D" 3 tanks	Average life 32 years
WHITE PINE	
Railroad "A" 24 tanks	Average life 29.7 years
Railroad "E" 12 tanks	Average life 35.4 years
Railroad "F" 4 tanks	Average life 29 years
Seven Railroads 184 tanks	Average life 30 years
Average Life of 106 Tanks Relieved.	
Cypress.	
Railroad "B" 24 tanks	Average life 27.3 years
Railroad "G" 16 tanks	Average life 30 years
Railroad "D" 3 tanks	Average life 32 years
—	—
43	29 years
WHITE PINE	
Railroad "H" 27 tanks	Average life 27.5 years
Railroad "B" 22 tanks	Average life 25.8 years
Railroad "I" 14 tanks	Average life 23 years
Railroad "F" 4 tanks	Average life 29 years
Railroad "D" 3 tanks	Average life 33 years
Railroad "E" 3 tanks	Average life 38.3 years
Railroad "C" 5 tanks	Average life 27 years
—	—
78	Average life 27 years
YELLOW POPLAR	
Railroad "C" 3 tanks	Average life 30 years
RED CEDAR.	
Railroad "C" 1 tank	Average life 28 years
YELLOW PINE	
Railroad "C" 1 tank	Average life 29 years
Eight Railroads 126 tanks	
Average life 28 years	

It will be noted that the white pine tanks show a higher average life than the cypress tanks in the table of tanks still in service while the opposite is true in the table of tanks relieved. This may be explained by the fact that cypress tanks were not used as extensively as white pine tanks up to 20 years or so ago, and on the roads shown there are probably many white pine tanks which were in use before cypress tanks were constructed, although there is apparently very little difference in the durability of the two woods.

It is interesting to note that a yellow pine tank is shown with a life of 29 years while the life of a yellow pine tank as constructed to-day would probably not exceed 12 years. This difference in life can possibly be explained in the fact that the trees from which the tank mentioned was cut had not been bled of the rosin and preservative oils natural to the wood. It should be explained that the life of 28 years given the red cedar

tank did not represent the extreme life of the timber as when the tank was taken down the best of the timber was used in the construction of a smaller tank which is still in use. The original tank was constructed in 1870, which makes the timber in the smaller tank 48 years old.

In the letters received many records were given showing a life of only 10 to 15 years for cypress, white pine and redwood tanks. This was unfair to the timbers mentioned as the short life obtained was undoubtedly due to poor selection of timber, poor construction, the tank not being kept filled with water or some one or more of a number of faults that would cause early decay.

Protecting Water Mains, Fire Hydrants and Valves Against Freezing in Winnipeg

By Mr. T. H. Hooper*

All hydrants immediately after use in winter seasons are repacked with a composition of tallow and hemp packing, placed in the stuffing box in hydrant head; otherwise the operating nut would be frozen solid and the hydrant placed out of commission. Occasionally, through a faulty drip, the water will rise in the post, when a steam boiler is used for the purpose of forcing steam into the post to thaw it out.

When a hydrant is found out of repair, the fire brigade is notified, and when placed in commission the brigade is informed. All repairs to hydrants are treated as emergency jobs, and workmen stay until repairs are completed.

Hydrant repairs are divided into two classes, light and heavy. Light repairs consist of repacking, renewing bolts or nuts, and renewal of parts which can be made without digging out the hydrant. Heavy repairs are occasioned through foreign matter being drawn into the hydrant, such as sticks or stones which have been left in mains at time of construction or the breaking of post or valve.

It is most essential that in laying water mains it should be the duty of some man to inspect each pipe as it is laid, and at night when men lay off work to block the end securely to prevent children from throwing stones in the pipes.

Hydrants are placed at approximately 300-ft. intervals on all new mains laid, the water works receiving an income from the city at large of \$30 per hydrant per annum to offset the water consumed and the maintenance of the hydrants.

Considerable trouble was experienced in past years, owing to unauthorized persons operating hydrants, using at times alligator wrenches or large monkey wrenches, and in doing so stripping the edge off the operating nut, which is pentagonal in shape. The writer was successful in having a by-law passed, making it a misdemeanor for any one (except the fire brigade) to use a hydrant without first securing the permission of this department.

Valves

There are in use in this city at this time 2,360 hydrants and 4,005 valves on domestic service. Valves are inspected the same as hydrants, as it is necessary in case of a break during a fire to localize the break by shutting off the least possible length of main.

Valve repairs are far more frequent than hydrants,

caused generally from broken bolts, broken spindles or foreign matter such as sand, stones or sticks blocking valve so as to prevent it being properly closed when required.

The fire service water works system or high pressure which is supplied with water from the Red River receives the same close attention as the domestic system, there being 158 hydrants and 298 valves.

Water Mains

Water mains in this city are laid at an average depth of 7 ft. 6 ins., and in spite of the intense cold, frozen mains are almost unknown. Last year a main in an outlying district was found to be so nearly frozen that only a small stream could be secured at the hydrant. The hydrant was left open, when the water gradually cut the ice away and in time freed itself.

The only other case the writer remembers was where a 10-in. main was frozen solid. To free this main, it was necessary to make four excavations at a distance of 40 ft. apart; the main was then tapped with 1-in. holes and thawed out with steam from hose inserted in the holes.

If water mains were laid properly in the first place there would be very few repairs required except in the case of electrolysis.

The writer had occasion recently to cut out some sections of cast-iron water main which had been in service for the past 34 years, when it was found that the pipe and asphaltic covering was in just as good condition as when laid, there being not the slightest trace of wear. Therefore, if joints were properly made and pipe sufficiently tested prior to laying, there would be very little interruption in the distribution system, guaranteeing a full supply when called on in case of fire.

Frost Penetration Last Winter

The report of the Committee on Frozen Water Mains of the New England Water Works Association, submitted at the September meeting of the association, includes much information on the frost conditions encountered last winter in various sections of the country. Forty-three cities reported that frost was noted at depths of 6 ft. or over. In 57 cities the average depth of frost penetration was 4 ft. or over, while 27 cities reported an average depth of 5 ft. or over. The greatest depth noted, 9 ft., was at Duluth and St. Paul, Minn. In the first city the penetration was in clay, and rock soil; in the second it was in sand and gravel. At St. Paul the average depth was 7.5 ft. Depths of 8 ft. were noted at Winnipeg, Man., in gravel soil, and at St. John, N.B., in clay soil.—Engineering & Contracting.

On January 1, 1919, Canadian SKF Co., of Toronto, open a sales office at 412 St. James St., W., Montreal, Que., under the direction of Mr. Geo. Sheppard, where they will carry a large stock of double row self-aligning ball bearings, single row ball bearings, automatic drill chucks, ball bearing hangers and pillow blocks, and "Quality" steel balls.

The Verdun, P. Q., council have decided to ask the Provincial Legislature for authority to borrow three hundred thousand dollars for additions to the water and electric plants, repairs and reinforcements to the filtration plants, and for works to strengthen the dyke for protecting the town from floods.

*Operating Superintendent Winnipeg Water Works; from a paper before National Fire Protection Association.

High School at Ville St. Pierre, P.Q.

A Splendid Example of Modern Fireproof Educational Building Erected for the Protestant School Commissioners

THE West Hill High School, now being completed for the Protestant School Commissioners of Ville St. Pierre, P.Q., is an example of the best type of educational buildings. It was designed by Mr. D. J. Spence, architect, Montreal, and is being constructed by A. E. Byers & Co., Limited, Montreal.

The building covers an area of 155 x 90 and consists of a sub-basement, basement, and three storeys, being constructed of reinforced concrete on the Truscon system of the Trussed Concrete Steel Company of Canada. The exterior is of reinforced concrete to the first floor, and brick and cast cement for the remaining portion. There are three entrances in the front elevation; the main entrance is reached by cement steps, and leads to the ground floor. The other two entrances give admittance to the basement, one for girls and one for boys. The feature of the front elevation is the large window space in the centre, all of steel sash, with 12 windows on either side. Above the main entrance are the words "West Hill High School," in cast cement. The cornice is of galvanized iron, the coping of concrete, and in addition there is a coat of arms and urns of cast cement.

The foundations are of concrete, with spread footings. A small amount of water was encountered when excavating, but this was carried off in the sewers. In the sub-basement and basement R.I.W. toxement was used for waterproofing. All the interior partitions are of terra cotta and brick. The floors are of the Truscon metal floortyle system, with spans generally of 22 ft., the reinforcement being of truss bars. The floors are of cement finish and also of hardwood.

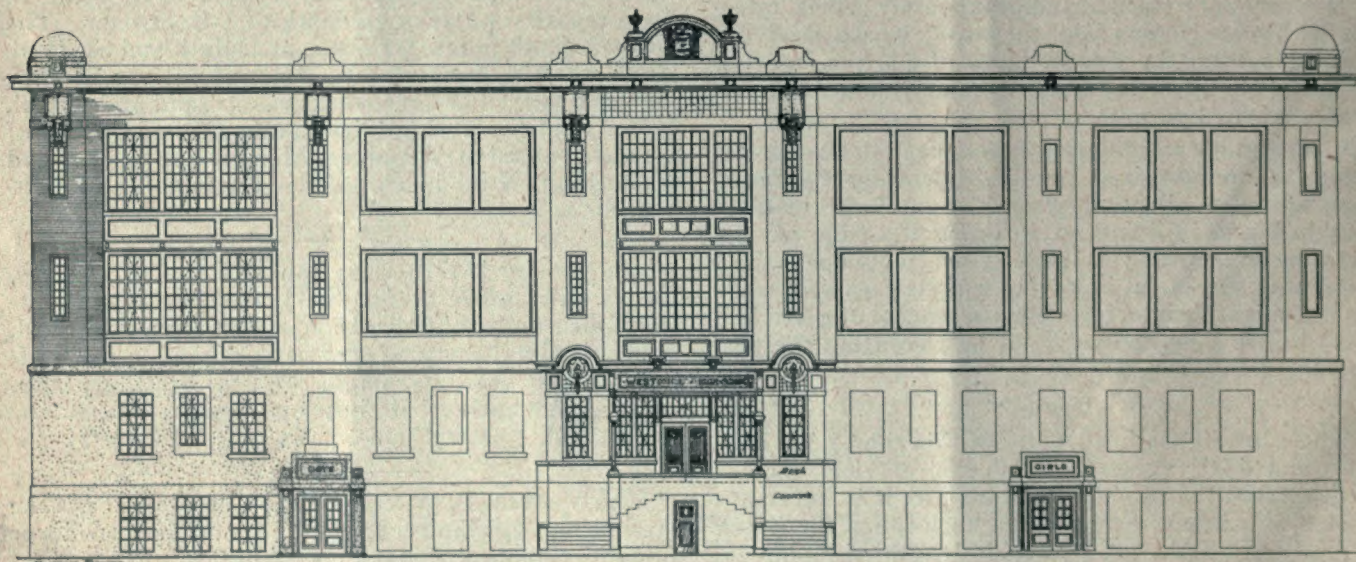
The boiler room, containing two boilers, is located in the sub-basement, with a fan-room, 2 coal bunkers, each 17.6 x 19.6, the various departments being separated by concrete walls.

The basement is devoted to boys' and girls' play-rooms, one at each end; lavatories, lockers, shower baths, janitor's store, and a gymnasium in the rear, this room being 48 x 60 ft. and 16 ft. high. There are separate entrances for boys and girls to the basement from the rear; these entrances lead to separate fireproof stairways, which are continued to the top floor. The stairways are enclosed in brick walls lined with 4 inch buff brick; the doors on each floor, cutting off these stairways, are kalomined metal fireproof doors. The stairways are of concrete.

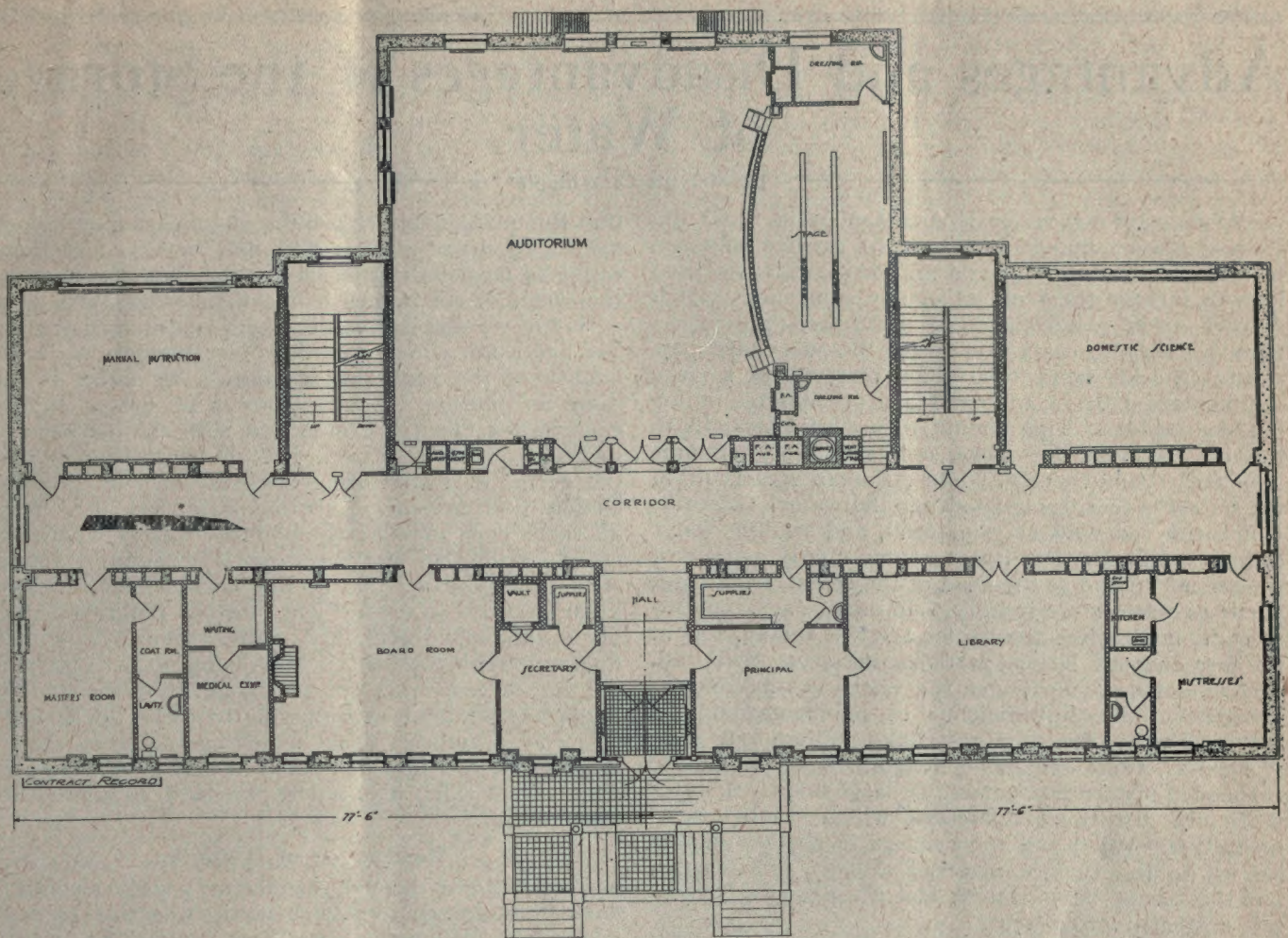
On the ground floor the vestibule at the main entrance leads to various rooms for the officials. These include principal's, mistress's, board, medical examinations, masters', writing, coat, secretary's, and supply rooms and kitchen. A wide corridor runs through the centre, and on the rear side of this are the rooms provided for the manual instruction and domestic science classes and a very large auditorium or assembly hall with stage, and dressing rooms on either side of the stage. A fire escape of structural iron is located on the outside of the building with an exit from the auditorium.

The entire length of the front portion of the first floor is occupied by five class rooms, each about 22 x 25, with coat rooms adjoining. At the other side of the corridor are also class rooms and the gallery of the auditorium, provision being made for a moving picture machine. There are dressing rooms on either side above the stage.

Another five class rooms are located on the second floor, while at the end of the corridor is a store room. Other rooms on this floor are the art room, chemistry laboratory, and lavatory. The roof of the auditorium is on a level with this floor, and contains a skylight over the stage with movable sections held in place by fusible links. This roof is supported by a steel truss,



Front Elevation of West Hill High School, designed by D. J. Spence, Architect, Montreal.



Ground Floor Plan of West Hill High School, A. E. Byers & Co., Limited, Montreal, General Contractors.

while the floor over the gymnasium is upon huge steel girders. The latter are enclosed in concrete. The roof drainage is on the inside.

There is no provision for janitor's quarters in the main building, but a small brick cottage with slate roof has been constructed upon the rear of the lot for the janitor. This cottage is built upon concrete foundation and has in the basement accommodation for heating plant, coal storage and laundry. On the ground floor it has a large kitchen to be used as a combination kitchen and dining room and a living room, while the first floor has two bed rooms and a bathroom.

The following were the sub-contractors: steel, Dominion Bridge Co., Limited, Lachine; plumbing, heating and ventilating, Hickey & Aubut, Montreal; painting, Alexander Craig, Limited, Montreal; wall furring and partitions, Montreal Terra Cotta, Limited; roofing and sheet metal, McFarlane Douglass Co., Limited; electric light, A. A. Giddings & Co.; steel sash, Trussed Concrete Steel Co.; plastering, R. H. Clark; electric fixtures, Robert Mitchell Co.; wrought and cast iron, Fred McKay.

Electric Lights in Operator's Cab Show Location of Cableway Bucket

An indicator board containing twenty-four numbered electric lights, set up in front of the hoist runner on the cableway on the Queenston-Chippewa power development at Niagara Falls, tells the hoist runner where the bucket is at any moment. The lights on the indicator are lit through a circuit closed by a

contact, on the haulage drum, which is made and broken with every revolution of the drum. The lights thus show the progress of and the distance in feet traveled by the bucket out across the river and back again to the dump. The numbers under the lights show the hoist operator the exact digging position of the bucket, and prevent him from making a hole in the river bottom, which would lower the efficiency of loading. The indicator also makes accurate and rapid night work possible. The device was rigged up on the job under the direction of G. H. Angell, general superintendent.—Engineering News-Record.

Contracts for four more ships under the government shipbuilding programme have been let: Two steel vessels of 8,200 tons to Mullin Bros., at Prince Rupert, B.C.; two coasting vessels to Nova Scotia Steel Co.

At a meeting held in Sherbrooke, on December 23, it was decided to organize a Builders' Exchange, and steps are to be taken to secure incorporation by the Provincial Legislature.

The steel shipbuilding department of the Imperial Munitions Board has removed from Ottawa to the Drummond Building, St. Catherine St. West, Montreal.

The Dominion Bridge Co. has secured contracts for the steel portions of three bridges for the Canadian Government Railways.

Advantages and Disadvantages of the Storage of Water

By Melville C. Whipple*

When running water is arrested in its flow the force of gravity immediately exerts a greater influence toward purification. The term "purification" is used here to include the removal of any substances which detract from wholesome or attractive properties. Gravity tends to carry downward the suspended particles. A lake, pond or artificial reservoir is a large sedimentation basin and in it are precipitated injurious substances. The amount of material brought to the basin is often very large, as in the case of streams which carry much clay. The Ashokan Reservoir in the Catskills receives in floodtime the water of streams which run red with clay material, and yet the water discharged at the gate-house contains only a trace of the amount found at the head of the reservoir. Larger particles settle more rapidly than small ones. Microscopical bodies like the bacteria settle slowly, but in the presence of larger particles many of them are carried down. The longer the water is retained the greater will be the efficiency of sedimentation. In bodies of water like the Great Lakes, where long storage exists, there remains no visible trace of all the suspended matter that enters. In large bodies of water there are disturbing influences which combat sedimentation. Wind and wave action in shallow depths carries to the surface material already precipitated, but this action is spasmodic and the net effect registers a great improvement.

Reduction of Color.

Decolorization is another process which goes on with advantage in stored waters. A great reduction in the color of such waters occurs after storage for several weeks or months. In the Hobbs Brook Reservoir, supplying a portion of Cambridge water, the color at the upper end averaged 75 on the platinum scale during 1916, while that at the lower end averaged 18. In the Wachusett Reservoir of the Metropolitan system the reduction was from 36 to 17. Various causes contribute to this improvement. At the surface the bleaching action of sunlight causes a decomposition of the coloring matter. Experiments have shown a reduction of about 50 per cent. in a month. Below a depth of 5 feet the action is not appreciable owing to exclusion of light. Oxidation by beneficent forms of bacteria also plays a role; but the greatest factor of all is probably due to a neutralization of electric charges carried by the color particles. This results in their coming together to form particles large enough to settle out. The last phenomenon is as yet imperfectly understood. The total effect of all the forces operating to bring about decolorization is that water which was unattractive to sight and taste undergoes such an improvement in quality as to be available for use.

Equalizing Effect on Quality of Water.

Another factor operating strongly for purification in large basins is the equalizing effect on the quality of the water. This involves no other action than that of simple mixing. Analyses, both chemical and bacteriological, of the water entering reservoirs will show

that the quality varies at different times, sometimes in a striking degree. If it was not for this fact there could be no equalization of quality; but inasmuch as the water is sometimes worse than others, if a long period of storage is provided there is a mixing of good and bad water which smooths down fluctuations in the quality of the incoming streams. The effect is the same as dilution. Equalization is of special significance when taken in connection with the hygienic or bacterial quality of water. It is undoubtedly true that the germs of water-borne diseases, such as typhoid, cholera and dysentery, are not uniformly present at all times even in sewerage-polluted waters where the colon bacillus of the intestine is constantly found. Attempts to isolate the typhus bacillus, for instance, are not always successful when heavily polluted waters are examined. Infection of water, then, occurs with fluctuations in intensity. This being so, it is easy to see that there is much greater danger from the epidemiological standpoint of supplying to a filter, or directly to a city, a polluted water which has not been stored. A heavy dose of infective material may be encountered at intervals when it is not expected, if storage is not made use of.

Destruction of Bacteria.

It used to be thought that the only factor operating during storage to remove bacteria was that of sedimentation. We now know that by far the greater action is due to certain "devitalizing" processes now going on naturally, which result in the final extermination of disease-producing microbes. In temperate climates the typhoid bacillus is more often the cause of water-borne epidemics than any other organism, and for this reason it has been the subject of many lines of research study. Much is now known concerning its length of life in water, the effect of temperature upon the rate of destruction and various other matters. The researches of Dr. A. C. Houston, of the London Metropolitan Water Board, have probably been the most exhaustive along these lines and likewise as well received as any. The question of the influence of storage upon the quality of water has long been an important one to the city of London, as most of its water is derived from the Thames and other polluted rivers, the water being stored in large basins for a period of about 15 days and then filtered.

Very complete tests were also made by Dr. Houston to determine the effect of temperature upon the death of typhoid bacilli in water. His findings were directly opposed to some of the earlier work but are now generally accepted. They indicate that temperature is an important factor and that the vitality of the bacillus persists longer with lowering temperature.

The results indicate that the life of the typhoid bacillus is longer in the cold months of winter and early spring. At this time any dejecta from patients, if it is thrown on the ground, has its best chance of reaching the consumer. Cold weather protects the bacteria and the melting snows and rain hurry them along on their journey. On the other hand, the greatest number of typhoid cases occur in the late summer and fall. At

*From paper presented before the School of Public Health, Boston.

that time the stream flow is less and the temperature is nearer the average for the year, or possibly higher, and so the typhoid microbes have a precarious time. Other forms of bacteria, except some common soil and water forms, are also found to decrease rapidly in stored water, but the disease bacteria and strictly body forms, like bacillus coli, show a greater rate of decrease. It is apparent from the work of Houston and others that storage provides a great protective barrier for the consumer against the germs of water-borne diseases. The use of small basins is an aid in this direction, although several weeks' storage is necessary to the absolute destruction of disease-producing bacteria.

Disadvantage of Storage.

Among the disadvantages of storage is one that arises in connection with color. In all ponds and large bodies of water there are three zones marked by differences in temperature. Assuming a depth of 50 to 100 feet, we find from April to October in the upper 15 to 25 feet, water of uniform temperature which is in active circulation both horizontally and vertically. Below this for perhaps 15 feet is a zone where the temperature drops rapidly, sometimes 10 degrees in a foot. The movement of water is in the opposite direction to the zone above. Finally below this middle, or transition zone, is one where there is almost no movement of water. This is the only portion of a reservoir which may be said to afford stagnant water. Everywhere else the water is in circulation. If it is necessary to use water from this zone it will be found to have color considerably higher than the surface, and this color may temporarily increase upon exposure to air. It is due to soluble organic matter in combination with iron which has been taken up from the slime and soil at the bottom. When the iron becomes oxidized upon exposure to the air it settles out and carries much of the color with it. To a considerable degree this trouble may be obviated, for a few years at least, by removing all the vegetation, roots and mucky soil from the land which is to be covered with water. The procedure is expensive, costing over \$2,000,000 for the Wachusett Reservoir. When the Ashokan Reservoir was built subsequently the benefits were not deemed commensurate with the cost, and no soil stripping was done, although roots were grubbed out near the flow line of the reservoir. Experience to date with this reservoir has justified the procedure.

Dangers from Stored Waters.

Aside from the trouble caused by growths, which after all are "minor horrors," there are at times positive dangers from stored waters. When we divide the capacity of a lake, pond or reservoir by the amount of water taken from it each day a figure is obtained which represents the nominal period of retention in that basin. It is not correct to assume from this that all the water entering is confined for that period. Mixing is not as thorough and complete as this, except in shallow basins. I have already mentioned the zone of colder, quiet water which lies at the bottom from about April to October. There is a similar although less pronounced condition in the cold winter months, when the bottom layer is slightly warmer than the top. Water which enters a reservoir stratified in this manner does not mix well with the quiet water but tends to flow over it. The period of storage is thus shortened and the time for purification lessened by that amount. Polluted water entering the basin reaches the outlet

sooner than it would if the temperature was uniform from top to bottom. Mixing would then be more thoroughly accomplished. The general shape of the shore line and the location of the outlet sometimes afford another element of danger, and give rest to "short circuits." There may be a direct line of flow from the inlet to the outlet which does make use of the total storage available by reason of bays and coves where the water does not mix. The ideal arrangement is one which makes use of projecting portions of a shore line to cause the water flowing through the basin to pursue an irregular course. The effect is the same as interposing baffles in a small basin. Mixing is much more complete. A direct line of flow may be necessary with regular shore lines and also prove perfectly satisfactory under usual conditions. It may not afford protection under unusual conditions. A high wind for several hours or days may blow straight toward the outlet and set up a rapid movement of the water in that direction, or a sudden freshet in the spring may bring in a lot of warm water. It has been observed many times that this warm water does not mix readily with the cold water already in the basin because it is not as dense. Instead it spreads out in a sheet over the top of it. If this incoming water carries with it the microbes, say, of typhoid fever, little time is given in the reservoir for their destruction, and they may persist in the water leaving the reservoir. The combination of freshet, wind and pollution may break down the protective barrier of any storage basin.

Conclusions.

In conclusion it may be fairly said that the storage of surface water affords a very effectual means for safeguarding their hygienic quality. The dangers arising from the use of impounded water supplies come from inability to make use of a proper period of storage under some unusual conditions, and not from the failure of the natural processes of purification to be carried on. The use of stored waters is also attended by certain disadvantages, chiefly a temporary increase of color, and the production of tastes and odors from the growth of microscopic organisms. These are overcome in large measure if artificial means of purification are later employed, such as filtration. The benefits and advantages which accrue from storage, on the other hand, are numerous and pronounced in their effect. Most important of these is the reduction in the numbers of nearly all forms of bacteria, and especially of those forms found normally or occasionally in the human and animal body. Water is not a favorable environment for the existence of any of these. Research has shown that the disease-producing bacteria, like the typhoid bacillus, succumb in a very few weeks at the longest. Storage also improves the physical properties of water by allowing the precipitation of sediment and the removal of coloring matter, changes which render it more attractive for human consumption. The equalizing effect of large basins is likewise of great importance.

The honour of capturing the town of Mons fell to the 3rd Division of the Canadian army, under the command of Major-General F. O. W. Loomis, C.B., C.M.G., D.S.O., of the firm of D. G. Loomis & Sons, general contractors, Montreal. The city conferred the title of Citizen of Honor on Gen. Loomis and also on General Clark, commanding the 7th Canadian Infantry Brigade.

Academy St. Bernard, Shawinigan Falls, Que.

The Academy St. Bernard recently erected in Des Cedres, Second and Third Streets, Shawinigan Falls, is the latest addition to the many important educational buildings in the district of Three-Rivers, P.Q.

The Roman Catholic School Commissioners at Shawinigan Falls, P.Q., with a view to providing a modern school, commissioned Mr. J. O. Turgeon, architect, 55 St. Francois Xavier St., Montreal, to prepare plans for a three-storey structure. This academy contains fourteen class rooms and the general contract was awarded to Messrs. Bellefeuille & Trepanier, General Contractors, Three Rivers.

The main building is 140 ft. 8 in. x 58 ft. 4 in., to which has been added an extension as a residence for the teachers. The foundation is of concrete, mixed in the proportion of 1 : 3 : 5, which above grade has been faced with cut limestone. In the cellar, the flooring, 6 in. thick, is of 1 : 3 : 6 concrete, and space has been provided for the installation of four No. G Brunnelle hot-water furnaces.

The building is of brick. The perron, lintels and the inscription above the main entrance, etc., are of



General view of school showing new residence in rear.

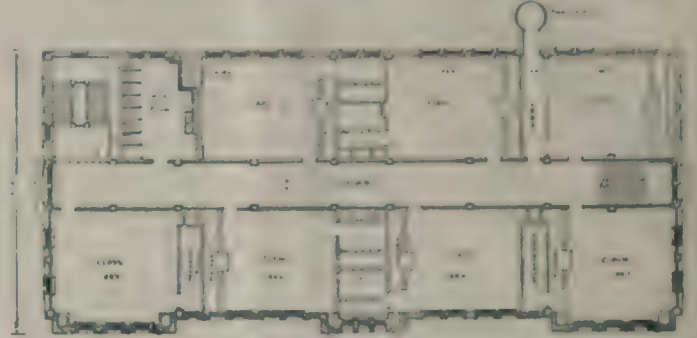
Roman stone and cut limestone. The building is well lighted on four sides.

On the ground floor, the main entrance leads to a reception hall, shown in the accompanying illustration. The beams, girders and columns are covered with terra-cotta. There are two other entrances, one on Second street, which leads to a vestuary and to the reception hall, a parlor being on one side, and on the other, the stair to the first floor. The other entrance, on Third street, leads to a vestuary.

The flooring is of concrete over hollow tile. The reinforced concrete girders, in T-shape, are 36 in. deep under the floor slab, or 42 in. deep, including thickness of floor slab. The reinforcement consists of ten pieces of 1- $\frac{1}{8}$ in. round bars, straight, 27.5 ft. long; six pieces of same diameter, 33.5 ft. long, trussed; thirty stirrups, in W-shape, made of $\frac{3}{8}$ in. round steel bars 15.1 ft. long. The beams are 8 in. x 14 in. and from 14 ft. to 17 ft. in span, reinforced with round bars—2 pieces, $\frac{3}{4}$ in. diameter x 16 ft. 10 in. long, straight; one piece, $\frac{3}{4}$ in. diameter x 21 ft. 9 in. long, trussed; 16 stirrups, $\frac{1}{4}$ in. in diameter x 4 ft. 9 in. long. On this

floor has been located a number of water closet cabinets finished with terrazzo flooring.

The first and second floors contain seven classrooms each, which are completely equipped with black-

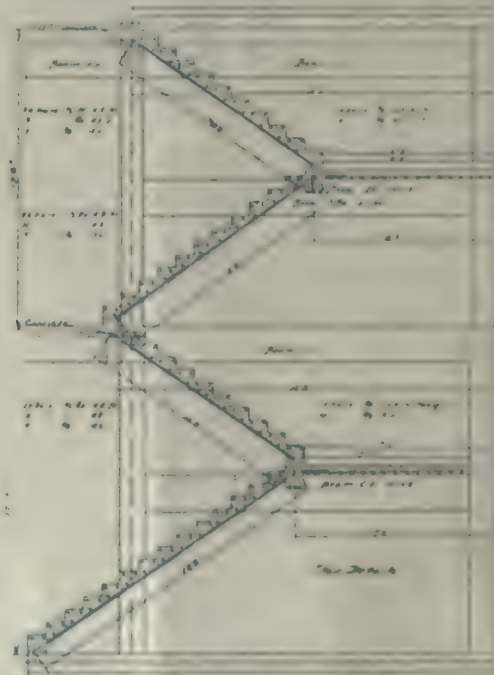


FIRST STORY

Ground floor plan.

boards, platforms, dressing vestiaires and wardrobes. These class rooms are laid out on each side of a lobby 10 ft. 6 in. wide. The flooring is of concrete on hollow tile carried on concrete beams 8 in. x 10 in., reinforced with three round bars $\frac{7}{8}$ -inch diameter trussed; also 16 stirrups $\frac{1}{4}$ in. in diameter. The girders are T-shape and are 20 in. high or 28 in. including the thickness of the floor slab. The spans between girders vary from 25 ft. 10 in. to 10 ft. 0 in.

In the mixture of concrete, alluvial sand was recommended and the crushed stone has to be of a size



Detail of reinforced concrete stairs.

to pass through a ring 1 in. in diameter. The mixture for beams and girders was 1 : 2 : 4 and for the columns 1 : 1 $\frac{1}{2}$: 3. The ground floor has been calculated for a live load of 125 lbs. per square foot; the first and second floors, for a live load of 70 lbs. per square foot.

Sixty thousand feet B.M. of lumber 1-inch thick was required for the forms. One hundred and sixty-five thousand lbs. of round steel of different sizes was required for the reinforcement of concrete. The cost per unit of the reinforced concrete is estimated at \$20.00 per cubic yard finished; for the mass concrete, \$9.00 per cubic yard. Walls, including partitions, also the columns, are finished with terra cotta from 2 to 4 in. in thickness.

The roof structure is of wood and consists of 3 in. x 4 in. posts (double) laid on double railings 3 in. x 4 in. supporting the rafters, which are 2 in. x 8 in. at 2 ft. 6 in. centres.

In all class rooms, lobbies and the reception halls, the floors are finished with $\frac{7}{8}$ -inch hardwood planking, securely nailed to 3 in. x 4 in. nailing strips set in the concrete. The roof flashing is galvanized iron, marked "Apollo" No. 26.

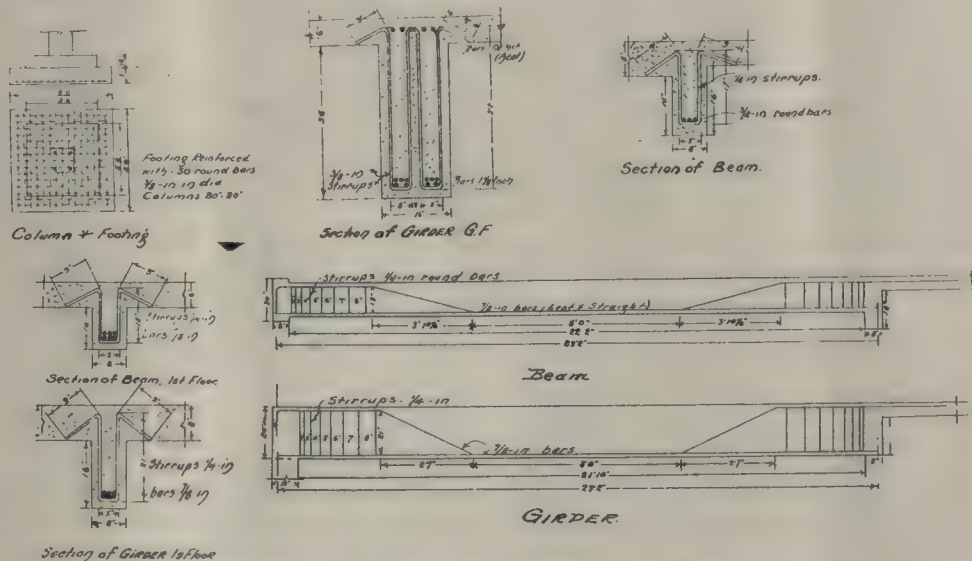
The columns are reinforced concrete set upon reinforced concrete footings 15 in. deep, with or without

Snow Removal on Trunk Highways

WITH the increase in motor traffic the problem of clearing the snow from Canada's main highways is annually assuming larger proportions and the following extracts from an article by Mr. Charles J. Bennett, State Highway Commissioner of Connecticut, at a recent conference on "Snow Removal from Trunk Highways," under the auspices of the National Highway Traffic Association, are of timely interest:

Two things are evident: First that the snow must be removed; second, that it must be removed by the agency responsible for the condition of the highways.

In consideration of the first idea we know that the traffic has developed to such a point as to demand continuous service on main travelled motor routes for twelve months in the year. This fact cannot be evaded. The motor is here; it has its place in our national life and in order that it may give us efficient and max-



Reinforced concrete details, Academy St. Bernard, Shawinigan Falls, Que.

another 12-inch step. The footings are reinforced with $\frac{3}{8}$ -inch round bars. The columns vary in dimensions from 20 in. square to 12 in. square reinforced with four vertical rods and hoops.

The school is to be completely equipped with modern school equipment and the cost completed will amount to approximately \$160,000.

Sub-contracts have been awarded as follows: Plumbing, Richard and Bergeron, Shawinigan Falls; tile, The Lepage Marble Works Ltd., Lachine; blinds, Lavigne Window Shields Ltd. Montreal; limestone, Jos. Neault, St. Marc des Carrieres; brick, T. A. Morisson, Montreal.

The Advisory Council for Scientific and Industrial Research is reported to be arranging to publish, in co-operation with the Department of Mines, a concise and handy reference bulletin on Canadian building stones, giving information as to their wearing and weathering qualities, comparative economic values, sources of supply, etc. At present the most complete information on this subject is that contained in voluminous reports made to the Government from time to time by Dr. W. A. Parks. A more concise compilation would doubtless be welcomed by contractors and engineers.

imum service such service must be continuous. The establishment of rural routes, the utilization of trucks and passenger motors command the attention of highway engineers, and the snow removal problem becomes a vital issue to be solved at once and successfully. This is not a war problem but an activity that has come to stay.

On the second statement, namely, that the state highway department must perform the work, it must be admitted that the work will never be properly done if left to the ordinary country or town agencies. The results would be of different standards and in many cases reached tardily or not at all. Then, too, the fees for motor licenses are almost invariably turned over to the various highway departments for highway maintenance and as inferred above, this work is recognized as a vital part of our maintenance problem. Add to this the fact that intelligent snow removal results in a decrease in cost of repairs in the spring and we may write "Q. E. D." after our two propositions.

A study of the subject reveals several fundamental principles which should be recognized:

First, that different sections of the country require different methods and degrees of snow removal.

Second, that the methods devised should take into

consideration the character of traffic and the number of vehicles of different classes to be accommodated.

Third, that the methods to be devised will depend entirely on the degree of removal required. For example, in the northern states where heavy snowfalls occur, it is not necessary to consider at the present time any system of snow removal which will allow the passage of trucks, because there are few trucks which need to be operated in these sections. The amount of snow to be removed is so great as to make the cost of the work prohibitive.

On the other hand, in the Atlantic tier of states where at times the snowfall is heavy, it becomes necessary to remove the snow so as to allow the passage of motor trucks, because these trucks are numerous and important to commercial activities. The universal use of other motor vehicles for business or pleasure purposes demands the removal of snow so that people may go about their ordinary pursuits by motor, even in the winter time.

The method of breaking our highways or for the removal of snow will depend, as noted above, on the character of traffic to be accommodated.

Again, certain fundamentals should be taken into consideration in devising a system of snow removal.

The problem of the trunk highway differs from the problem of the city street, since the area to be organized is so large that no one person can comprehend the amount and character of the work to be done or personally supervise the removal of any given snowfall.

Evidently snow can be more easily disposed on country roads than in the city streets.

Owing also to the necessity for promptness of action, a system must be devised which will go into effect immediately upon the appearance of snow and result in the prompt removal of the necessary amount of snow, such removal to be completed within a reasonably short time after the storm and to such degree as will permit of the passage of the preponderant class of traffic. The necessary equipment for the purpose must be provided and located at convenient points so that it can go into prompt action, in many cases without notice from headquarters.

Unnecessary work may often be done, but it must be recognized that this work is emergency work and the benefits in many cases are negative.

Keep Ahead of the Storm

The hours of labor should not be restricted, and the time of starting should be early enough so that the forces can get the best of the storm and always keep slightly ahead of it. For instance, it has been my experience in several cases where the department has not taken prompt steps to remove the snow as it fell that traffic was seriously hindered on account of this delay, and in some instances the satisfactory removal was deferred for several days after the occurrence of the storm.

The organization for this work should be elastic; the foremen or supervisors having the work in charge should have a free hand to employ the necessary men and teams to take care of an abnormal snowfall. A definite district should be allotted to each foreman, or sub-foreman, so that too much work will not rest upon one man. It is remarkable to note what an immense amount of work can be done with snow for a small amount of money, providing the work is undertaken promptly and under a systematic plan. Arrangements should be made so that the employees detailed for this work will report at headquarters as soon as a snow

storm commences and remain on duty until the work is done or is shown to be unnecessary.

One of the difficulties in handling snow is that the special equipment is in many instances not suitable for other purposes, so that an endeavor should be made to adapt the ordinary road making or maintaining machinery to the purpose of snow removal. This has been done successfully in many instances, particularly in the devising of scrapers or plows to be fixed to the front of motor trucks for the purpose of removing snow from highway surfaces. These trucks are successfully operated in cases where the wheels can secure a firm grip on the road surface, but are not satisfactory in operation where the snow is allowed to drift or to accumulate to a depth in excess of 6 in. which is again an argument for promptness of action.

Work should start on a continuing storm when the snow is 3 in. in depth.

Road Machines

Road machines may be used either drawn by horses or attached to the rear of a truck and hauled through the snow. The difficulty with road machines is the same as in the case of motor trucks—the wheels must have a bearing on the road surface in order to allow the work to be done successfully. As a matter of fact much of the snow removal work must be done and is done using draft animals and makeshift apparatus. This applies especially to those highways where drifted snow is to be removed in order that wheel traffic may be accommodated, the first operation consisting of running a team or several teams attached to a bob-sleigh over the road. Attached to this bob-sleigh should be some form of plow which will break out the snow on the surface of the road, and allow a more efficient type of machine to be handled by motor truck or tractor.

In cases of highways where it is necessary to provide for the passage of horse-drawn vehicles on runners, the use of snow rollers is advisable. These snow rollers consist of heavy wooden rollers drawn by horses or oxen. The rollers compact the snow so that the travel can pass over the top. There is no practical use for this method where trucks are to be used.

The main problem before the maintenance engineers of to-day is, however, the removal of snow on highways to accommodate truck traffic, and the points mentioned above should be re-emphasized; namely, promptness of action to a specified plan which should go into effect without notice if the telephone fails; lack of attention on the part of the help to hours of labor or the time of day when the work is to be done; and continued service until the trouble has passed.

As to the cost: In Connecticut with an unusual winter the total cost of snow removal for 1917-18 was approximately \$50,000 for 1,000 mi. of highway cleared with varying degrees of excellence and of varying depths of snow. In general, for work of this character in this section of the country, an estimate of \$45 per mile per year should be made where two lines of truck traffic are to be accommodated and the snow removed promptly.

In this work, advantage should be taken of the Weather Bureau. My experience has been that these reports are of value though at times they miss local storms and in some instances fail to predict serious snow fall. We are all relieved when a prediction of serious snowfall results in rain, or in no precipitation. In general, this bureau is an aid but not an entire reliance.

Standard Sizes of Crushed Stone from the Standpoint of the Producer

By Mr. R. W. Scherer*

THE movement to standardize commercial crushed stone sizes, inaugurated by engineers of the Bureau of Public Roads, should be and will be heartily welcomed by crusher operators. Economic plant operation is not the producers' only interest in the matter. They should be and generally are equally interested in the results from the type of construction involved and will be found willing to sacrifice economic operating to a considerable degree to gain better results.

It is difficult to see what a further survey of the screening practice and study of the nomenclature will do to clear up the situation. One could not expect to arrive at a typical set of screens by counting noses, nor by finding a majority of installations that are alike to which the minority would conform. It is also to be regretted that the investigators found it "impossible to record the rate of feeding the stone into the screen." That the nomenclature was in a condition of "confusion worse confounded" needed no demonstration.

How Product Varies.

To define a grade of stone all are agreed that size of screen openings through and over which the material passes must be stated. When these are stated the product may still vary from several causes.

First. There is an appreciable difference in the product of round and square perforations. A hole described as 2 in. square will pass a larger stone than a round one 2 in. in diameter. Square perforations are still used, though to a very small extent except in fine screens. It would be safe to confine the question to circular holes; where square perforators are retained they must be made the equivalent of circular openings.

Second. It makes a noticeable difference in the product whether screens are stationary or revolving. On a stationary screen the stone particles slide over the surface; they are held on their longest dimension. In a revolving screen the stones roll and can go through holes no larger than their smallest dimension. The difference in size of product is so great that the stationary screen will retain 20 to 40 per cent. of material that has been passed through a revolving screen of the same size perforations. This means that the specification still retained by some engineers—naming the largest dimension as the determining one is not practicable, since stationary screens are almost unknown in the industry. If engineers knew this, they might discontinue the practice. They could guard against "slivers" by other means.

Third. It makes a difference, of course, whether a screen of any type is overloaded or not. More often it is the large plant that has inadequate facilities for separating the sizes. Fines are carried over to the next section having larger openings. Thorough screening should be understood in designating sizes and how thorough it should be will be discussed in another paragraph.

Now, then, to get clearness in the matter of describ-

ing sizes. Let us describe a given product at least technically by the size of perforation which it passed through and the size of perforation that held it, and let us understand thoroughly that the figures are for a round perforation, for a revolving screen, and for a screen of sufficient capacity for the plant.

And if we can best describe a given product by maximum and minimum smallest dimension, for technical purposes, why not for all purposes? Why should there be the conflicting nomenclature of numbers and more or less descriptive names. In fact, dimensions are the one description that now is universally intelligible, and it would seem that for all practical purposes, ordering stone, specifying, invoicing, and all, it is just as easy to refer to 2-1 in. stone as it is to write or talk about 23 or medium fine stone.

Probably the best established and most universal system of nomenclature is that of the granite crushers both East and West, where No. 1 stone is always very nearly $2\frac{1}{4}$, $1\frac{1}{2}$, and $\frac{1}{4}$ in. and finer called No. 4. It would be very difficult to accustom the granite trade to another system of numbers, while they could be led to adopt the figures limiting the sizes.

Limiting the Number of Grades.

Once we have means of describing grades of crushed stone and it would seem that with the above understanding—2-1 in. stone or any other size would mean the same thing everywhere—a further understanding could be arrived at between the producers on the one hand and road builders, engineers and architects on the other hand as to grades that should be offered by the former and demanded by the latter.

The advantages to the crusher operators, if the number of grades can be reasonably limited, are manifest. There can be no question that there has been on the part of engineers—less of road engineers than of the specialists in structural concrete—considerable academic dogmatism about sizes for certain purposes—they have been just "finicky." But—and this is from the quarryman's standpoint as well as the engineer's—results must be considered. It is to the quarryman's interest—and some of them can see it—to furnish just the size that will give the best results. It is incumbent on all parties interested to ascertain how much of this fastidiousness is justified and in how far the results in road or concrete are affected by a slight variation from the size demanded by some engineer whom the quarryman thinks pedantic.

The Demands of Engineering Practice.

Here are some thoughts from the standpoint of the quarry operator who is interested in results, which it is hoped may illuminate the subject. On the one hand, some paving engineers using stone in a special process of asphaltic concrete paving have insisted on a product passed through a screen $\frac{1}{8}$ in. larger or $\frac{1}{8}$ in. smaller than was commercially produced. This seems to be pedantry that passes for scientific aggregating. In stone above 1 in., $\frac{1}{8}$ in. more or less can make no possible difference; even a $\frac{1}{4}$ in. variation seems unrea-

*Secretary, Wisconsin Crushed Stone Association

sonable in 1 in. and larger stone. The demand for such variations can be eliminated.

On the other hand quarrymen are at fault when they fail to recognize the imperative necessity for good screening. And here is where they should consider results. Stone for macadam must be distinguished from stone for concrete, and differently prepared. It makes no difference what the hardship on the quarrymen may be, results to a certain extent justify the sacrifice.

The distinction can be simply stated in this way: In macadam stone there must be a large percentage of voids, while in concrete stone the percentage must be as low as possible. To elucidate, no road builder can bind a crusher-run stone. Fines, when present in coarse stone, close the interstices and prevent the entrance of the binder even when that binder is hot tar. How much more must these fines prevent the entrance of stone screenings in water-bound macadam. In penetration macadam, road builders have had to discontinue the practice of dumping loads of the top course stone on the base, because as the load is spread with shovels the "fines" remain on the spot. The stone "mats"; the binder does not anchor in the body of the course, and a bald spot results. A large percentage of failures of "poured macadam" is due to poor screening. Fines should not be tolerated at all. The engineers of the Bureau of Public Roads suggest a maximum of 15 per cent. but 10 per cent. should be the limit; 0 per cent. should be aimed at.

There is no "finnickyness" about demanding good screening for macadam. Not only should the fines be removed, but the range of sizes in any one grade should be restricted as much as possible for macadam stone, and as wide as possible for concrete work. Thus, for macadam top course, 2-1½ in. stone is better than 2-1 in. The former being more even sized has more voids, and voids are what is wanted.

Screening Concrete Aggregates.

On the other hand, concrete aggregates must have a minimum of voids; the greater the range of sizes the better the results. Stone ranging in size from 2 to 1½ in. has 50 per cent of voids. To make a dense concrete, one-half of the concrete must be mortar, or a mixture of cement and fine aggregates. Well-graded stone ranging in size from 2 to ¾ in., when intimately mixed, has 35 per cent. of voids or less, leaving just that percentage to be filled with mortar. The efficiency of the cement in the latter case is increased from 35 to 50, which means over 40 per cent.

The proofs for this are abundant. Whenever and wherever coarse aggregates have been tested for the compressive strength of the resultant concrete the well-graded samples have stood the highest tests. In fact, from the vast number of experimental tests of fine aggregates, in which investigators all over the world have used three sizes designated as fine, medium and coarse, plotting their results on what is known as the Feret triangle, it is evident that 70 per cent. of the largest size permissible, 20 per cent. of the medium, and 10 per cent. of fine results in the best concrete. Why should not engineers insist that not less than 25 per cent. nor more than 50 per cent. of, say, a 2¼ in. concrete aggregate shall pass a 1 inch, and why should not quarrymen be prepared to furnish it?

Again, this is not pedantry. Why? A concrete made of all 2 in. stone and an ungraded sand is an absolute failure, it is full of voids and can be worked only with a detrimental excess of water. A great deal of

similar concrete has gone into bases of pavements and it is to be wondered at that there are not more failures. This specification would be no hardship on any crushing plant. It is not necessary that the two or three sizes required be mixed in a bin; they can be loaded on the cars or trucks, one over the other and would be mixed in unloading, at least in the case of cars unloading by shoveling. Mixing in bins is undesirable for another reason; a bin full of mixed sizes does not stay mixed. There is the well known separation by gravity, the large pieces always rolling to the outside of the pile. If the bin is large enough a rather close separation can be obtained by gravity.

Must Take Concessions.

These, then, are concessions which quarrymen must take for the sake of results, thorough screening in macadam stone and thorough mixing in concrete stone, both within reasonable limits. That state testing engineers and chemists are willing to concede the ridiculous fractional sizes is apparent from their preliminary report. (Department of Agriculture Bulletin No. 55.) They recommend the following screen perforations: 3, 2, 1, ½ and ¼ in. The nomenclature proposed consists of the numbers 3, 2, 1, ½ and 0, corresponding to the largest size contained in the grade. Thus No. 3 stone is 3-2 in. Combinations of the numbers are proposed: thus No. 1, 2, 3 means a mixture of ½, 1, 2, and 3 in. From the fact that this system of designating grades is the very contrary of the only system that has been at all firmly established in any branch of the industry, that of the granite quarries, it does not seem likely that its adoption universally could be successfully urged.

The logical system of describing grades seems the only one which we could hope to see adopted, that of specifying the limiting sizes. In this system stone for macadam base course would become 3-2 in. instead of No. 3, as is proposed, or instead of "ballast," "macadam," "2-in. stone," or "3-in. stone," as is now the confusing practice in different localities. Stone for cement concrete wearing surface would be simply 2¼ in. instead of No. 12, as is proposed. One-half inch screenings would become "½ in. and finer." There can be no doubt that the nomenclature would be universally intelligible and, with the restrictions mentioned above, would be accurate.

The First Conference of State Testing Engineers and Chemists evidently considered only road work; the requirements of structural concrete must be considered and this will probably add another screen and grade—1½ in. round perforations. This will not be seriously objected to by crusher operators, 2-1½ in. stone for second course macadam will give very much better results than 2-1 in. For concrete 1½-¾ in. material is vastly better, is as easily worked and will be more acceptable even for reinforced work than 1½ in.

Standardization Desirable.

The adoption of standard sizes is possible. The action of the Bureau of Public Roads in inaugurating a movement to bring this about is to be highly commended. Their engineers have shown a disposition to meet the producer more than halfway. If, in addition, other interests are considered, possibly the American Society for Testing Materials, the quarrymen who has conformed his screening plant to the standards prescribed, would have the highest engineering authority to protect him from the whim or caprice of pedantic road builders and engineers, and other engineers on

their part would be assured of getting what they specify. To recapitulate:

1. The establishment of standard sizes of crushed stone adopted throughout the States is possible and highly desirable.

2. To accurately define a grade of stone, screen perforations, through and over which it passed should be given. It should be universally understood that (first) circular perforations are meant, (second) that the screen is a revolving one, and (third) that the screening plant is adequate so that any one grade shall contain not more than 10 per cent. of fines (possibly 5 per cent.) and not over 5 per cent. oversize by laboratory tests, and that (fourth) a mixture of various grades such as $2\frac{1}{4}$ in. shall contain not less than 25 per cent. nor more than 50 per cent. of "fines" passing through a 1 inch screen, that is, through perforations having one-half of the diameter of the maximum sizes permitted in the mixture.

3. The following screen sections are proposed: 3, 2, $1\frac{1}{2}$, 1, $\frac{1}{2}$, $\frac{1}{4}$ in.

4. The nomenclature should be the logical one, simply stating maximum and minimum sizes.

Sarnia Presented with New Road

A very acceptable presentation was made to the city of Sarnia, Ont., recently by the Imperial Oil Co., in the form of a pavement on Milton St., extending to Green St. and to the Grand Trunk tunnel depot. This pavement was laid for the Imperial Oil Co. in the fall by the Warren Bituminous Paving Co., of Toronto. The formal presentation took place on December 19, when several of the chief officials of the company were present, including Hon. W. J. Hanna, M.P.P., president; Geo. W. Mayer, vice-president; C. O. Stillman, vice-president; G. H. Smith, A. McQueen, Daniel Strachan, and Victor Ross, of New York. Mayor Crawford expressed the city's deep appreciation of the company's generosity and spoke of the very friendly relations which had always existed between them during the twenty-one years since the firm's establishment at Sarnia. Mr. Hanna, replying for the donors, told how the idea of making this presentation had originated, and said he had readily endorsed it because he realized that Sarnia's supreme need, as is the supreme need of every other city and municipality was good roads.

Car Tracks Paved with Concrete

A street car line runs throughout the length of a newly paved street in Tacoma, Wash., and the tracks are being supported upon a concrete foundation. The pavement between tracks and rails will also be concrete, identical with the city pavement on each side of the tracks. The accompanying sketch shows the form of construction which has been adopted for the car track section.

International Fair at Lyons an Opportunity for Continental Trade Openings

On March 1st, 1919, the fourth International Fair to be held at Lyons, France, will be opened and will remain open for two weeks. This fair was organized during the war primarily to give impetus to French commerce. Its development during the four years it has been in existence has been phenomenal and it will probably replace the world-famed annual fair, which, before the war, was held at Leipsig, Germany. Mr. W. M. Clarke, Canadian Trade Commissioner at Milan, Italy, states that the fair is not a place where merchants assemble their products and sell them to visitors, but it is a sample show where producers and buyers meet and from samples shown important purchases are made, delivery of which is made direct from the seller on conditions that vary as regards time and place.

At the 1916 fair, there were 1,342 exhibitors and business amounting to \$10,400,000 was transacted. In 1917, there were 2,593 exhibitors and business valued at \$82,000,000 resulted. In 1918, there were 3,176 exhibitors who did business amounting to \$150,000,000.

It is worthy of note that of the 543 exhibitors from the United States in 1918, 405 displayed catalogues and price lists only, orders being placed under the direction of the American Consul-General at Lyons. Nevertheless, it is reported that the business transacted by United States firms formed a very important part of the total sales.

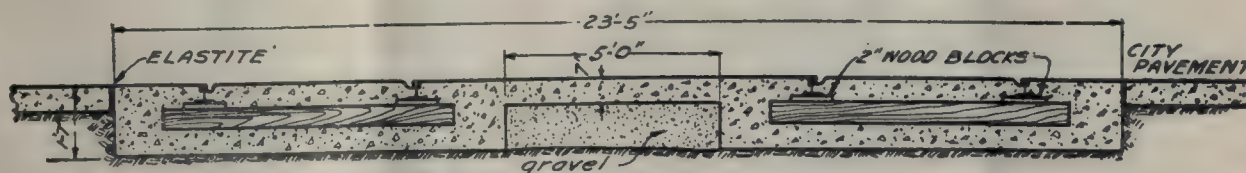
The Canadian Minister of Trade and Commerce has applied for thirty booths at the next fair. A few of these will be used for Government exhibits, but most of the booths have been placed at the disposal of the Canadian Manufacturers' Association for allotment, and application for space should be made to that Association. The Department will pay for the booths and also the freight on exhibits from the port of embarkation to Lyons.

This is an excellent opportunity for Canada to display what she can furnish to help re-build war-wasted France and at the same time improve our national financial standing. Canadian manufacturers should co-operate with the Department of Trade and Commerce to "get the business."

Montreal Tramway Extensions

Mr. Willard F. Graves, consulting engineer to the Montreal Tramways Company, speaking at a luncheon of the Kiwanis Club recently, said that extensions to the Montreal Tramway system would be commenced early next spring, as the company had been notified that the mills would commence rolling the required rails in January. These rails will be of the grooved girder type, weighing 115 pound to the yard. Mr. Graves stated that transportation systems throughout the whole continent were suffering from over-regulation by governments, municipalities and commissions and they were on the point of bankruptcy.

Mr. R. C. Marshall, the recently elected mayor of Calgary, Alta., is one of the principals of the Crown Paving Company, of that city.



Cross section through pavement showing car tracks.

The Relation Between Light Curtailment and Accidents

By Mr. R. E. Simpson*

From the published statistics of a number of states, together with conservative estimates for the remainder, we find that approximately 25,000 persons are killed or permanently disabled, 500,000 seriously injured, and 1,000,000 slightly injured, each year. Translating these figures by means of the accident severity rates we have a total of 180,000,000 days of lost time. This is equivalent to the loss of the services of 600,000 men for a full year of 300 working days. The economic loss is distributed over the entire country during a period of one year, and for that reason its effects are not so keenly felt, or its importance recognized. If, however, this loss were concentrated on any one of our basic war industries, as for example, shipbuilding, steel making, munition manufacture, or coal mining, it would be nothing short of a national calamity. Even distributing this loss among the four industries named would seriously cripple all of them.

It is apparent that we have here an important factor touching on the supply of labor, and anything that can be done to curtail this economic loss is worthy of careful consideration. There is a certain percentage of unavoidable accidents—that is, man's provision is unable to cope with unknown factors, and this is especially true of pioneer work. The best that can be done is to profit by experience, and endeavor to prevent the knowledge and experience thus gained from lagging behind practice. A large percentage of accidents may be classed as avoidable in the sense that the application of mechanical safeguards and the observance of safety rules will prevent them. Anything in the form of a practicable guard, of safety education, or of safety regulations that will protect the worker from injury should be welcomed by the plant manager to-day. Past investigations have indicated various influences on the causation of accident, and prominent among these is industrial lighting.

A survey of 91,000 accidents from the records of The Travelers Insurance Company for the year 1910 showed that 23.8 per cent. were due to improper or inadequate illumination. Bearing in mind the progress in the art of illumination during the past eight years, it is hardly possible that this percentage prevails to-day. New factories are lighted by up-to-date equipment, while many old plants have had their lighting systems brought into conformity with modern practice. These are steps in the right direction, and are bound to be reflected in the accident rate. Offsetting this, to a certain extent, is the practice of many plant managers of substituting high efficiency lamps, without providing adequate reflector protection. Notwithstanding the vast amount of expert advice that has appeared in the technical journals devoted to specific industries, there are literally thousands of plants that have not profited by this advice. The directing personnel of these plants, from managers to sub-foremen, do not seem to appreciate the difference between light and illumination, between a reflector and a wire guard.

18 Per Cent. of Accidents Due to Poor Lighting.

There is some foundation, however, for assuming that 18 per cent. of our industrial accidents are due to defects in the lighting installation. On that basis the services of 108,000 men for one year are lost annually, because the illumination provided is not adequate for the safety of the workers. That

this condition should exist year after year is all the more reprehensible because of the fact that the remedy is so easily applied and has beneficial results in many ways other than in the element of safety involved. Accidents caused by carelessness, inattention, or ignorance can be eliminated only by a long continued, painstaking educational campaign often involving a change in long established habits. The elimination of accidents due to inadequate or improper lighting is simply a matter of purchasing approved equipment and installing it under competent direction. In fact, it seems proper to include illumination in the list of mechanical safeguards, for the reason that the lamps and reflectors provide the guard—illumination—to point out the hazard, just as effectively as a railing points out the danger of and provides protection against the hazard of a revolving flywheel. The sum involved is insignificant when compared with the accident claims, or the lost profit on the product of the labor, or the value of the product itself.

Many Improper Installations.

Anyone who makes an extended survey of the lighting conditions of our industries will inevitably be impressed by the much larger percentage of improper installations when compared with the inadequate installations. This is due primarily to the praiseworthy, but none-the-less ill-advised, attempts to better the plant illumination on the basis solely of providing a greater candlepower output. The questions of distribution, diffusion and absence of glare are either not fully appreciated, or are entirely unknown, and therefore do not receive proper consideration. Now if the persistent efforts of several years have not wholly succeeded in educating the factory managements in the fundamentals of good illumination, is it not absurd to expect intelligent application of hurriedly promulgated rules for light curtailment? This in itself should be a sufficient argument against any such action, and it is rather gratifying to learn that there will be no general request for diminishing industrial lighting.

The saving in coal by curtailment of industrial lighting would be negligible when compared with the ultimate economic loss. If, for example, the full year's labor of the 108,000 men that is lost annually, due to poor illumination, could be saved and applied to coal mining, 130,000,000 more tons of coal could be produced. To provide ample illumination for the safety of these workers, ten hours a day for a full year, would require less than 10,000 tons of coal. We may convert this fact into a more detailed and concrete form by saying that a 25-watt lamp burning ten hours a day will provide adequate illumination on a stairway for one year by the use of one-eighth of a ton of coal. By dispensing with the lamp one-eighth of a ton of coal will be saved, but if during the year one accident occurs involving the loss of only one day's time the economic loss from a coal producing standpoint would be sufficient to operate the lamp 32 years.

More Accidents on Dark Days.

This brings us up to the point of considering the effect of diminished lighting at places where such reduction is almost invariably found. Stairways, elevated gangways, passageways, and storage spaces are generally inadequately lighted, and are the first to suffer from a policy of light curtailment. The hazards associated with these poorly lighted

*From a paper presented at the recent annual convention of the Illuminating Engineering Society.

sections of our industrial plants have been portrayed many times. Confirmation of these hazards has been given by the report of the British Government survey of industrial accidents showing that 40 per cent, more men are injured from falling and stumbling in the winter months than in the summer months. This is exclusive of street slipping accidents. The physical condition of the stairways and passageways is the same for both periods, the sole difference being in the illumination.

Many accidents occur in storage places due to inadequate illumination, but this fact is not often brought out in the reports. Raw material and finished product are often piled in uneven tiers, and these fall over at inopportune moments. Carelessness is very often the contributing cause, but in many cases a conscientious worker will pile material unevenly simply because the illumination is not sufficient to show him that the tier is out of alignment. Similarly, in storing tools or small parts on shelves some are placed too near the edge and fall on the workmen. A case in point is that of a young man who was storing small diameter steel rods. Unnoticed by him, one of the rods protruded a foot or more beyond the edge of the shelf, and in passing this point later on he received a jagged cut along the side of his head. There was a small-sized lamp in the central aisle, but none in the side aisle where the accident occurred.

Badly Lighted Passageways.

Even the supposedly well lighted working spaces in some shops are not immune from accidents of this nature. A certain work bench was well illuminated by local lights with proper reflectors, but the bench cast a shadow on the floor while the general illumination was not sufficient to offset the shadow. There followed a sequence of accidents due to the toppling over of partly finished work piled in the shadow. With a higher intensity of general illumination, accidents of this type were largely eliminated. Passageways that are traversed infrequently hardly justify the continual use of an illuminant, unless there is exposure to moving machinery or other hazards. Irrespective of the danger element, all passageways should have lighting units so installed that they can be turned on and off at either end. The lack of such a provision was partly the cause of an accident to a carpenter who had been called in to make some repairs in a chemical establishment. A cup had been placed to catch the drip from a slight nitric acid leak until repairs could be effected. The carpenter, assuming that the cup was placed to catch oil drip poured some of the acid on his saw and then rubbed it with his hand. Before neutralizing agents could be applied the palm of his hand was badly burned. It is evident that if proper illumination had been provided the carpenter would have noted that neither the color nor the consistency of the acid corresponded to that of an oil that might appropriately be applied to a saw.

A method is open to plant managers by which, at the same time, coal will be saved, better illumination provided, and accident hazards reduced. It consists in the universal use of reflectors. Every plant manager (as part of his lighting policy) should adopt the principle of a proper reflector for every lamp. In the field of general illumination, the use of unshaded lamps, in connection with naturally dark walls and ceilings, or with white walls and ceilings that have become dirty, is not only wasteful and inefficient, but also increases the accident hazard from bright light sources. Proper reflectors would bring this wasted light under control, and at the same time reduce the accident hazard. In a limited number of cases smaller lamps could be substituted and still ample illumination would be provided; but for the most part reflectors should be used with the lamps now installed to bring about a much needed improvement.

In the field of local lighting there is much more room

for saving and improvement. There are thousands of 120-watt carbon lamps, and many more thousands of 60-watt carbon lamps, used for local lighting about machines. It is the exception rather than the rule to find these lamps equipped with reflectors. Wire guards are more popular. For purposes of illumination a 15-watt or 25-watt tungsten-filament lamp with proper reflector would prove adequate. The question of serviceableness or of breakage of this lamp over the carbon lamp is dependent on local conditions. The recent agreement between lamp manufacturers and the Fuel Administration insures a reduction in the use of carbon lamps. In enforcing this policy, lamp users should be warned against employing tungsten-filament lamps without reflectors. Exposure to the high intrinsic brilliancy of the tungsten filament involves a greater degree of vision impairment than with the carbon lamp. Wire guards will not serve, for although they protect the lamp from breakage to a certain extent, they afford no protection to the eye. The lamp can be replaced for twenty-five cents, but the eye—vision—ininitely more valuable, cannot be replaced at any price.

During a recent inspection we noticed a workman at a stamping press who persistently stood at one side of his machine. In answer to our inquiries the workman stated that he could not see unless he moved to the side and closer to the lamp; and he also informed us that he was going to get a "big tungsten lamp." He was working on large tinned sheets and while standing in front of his machine a dazzling reflection was directed toward his eyes. A simple adjustment of his local light changed the angle of incident and reflected rays, and thus removed the trouble.

This incident is more or less typical. There is so much unintelligent use of light in the form of unshaded or improperly placed lamps that we are fast approaching the state of being a nation of eye-glass wearers. An important remedial step will be taken when we whole-heartedly get behind the movement of "a proper reflector for every lamp."

Wonderful British Naval Construction—One Destroyer a Week Since August 1914

The public knew from the various speeches delivered by Sir Eric Geddes and his predecessors at the Admiralty that very considerable additions have been made to the floating strength of the British Navy since the outbreak of war, but for obvious reasons little or nothing of a definite nature could be published in regard to this subject. Even now, when the ban on such publicity has been entirely removed, an appreciable period must elapse before it will be possible to describe in detail the process by which the British Navy has, in the past four years, attained a degree of strength such as it never previously enjoyed. Notwithstanding war losses, which have been far from light, the Navy to-day is considerably stronger, both relatively and absolutely, than it was in 1914. The heaviest losses have been suffered by types which were already regarded as obsolete, e.g., pre-Dreadnought battleships and armoured cruisers, and which, in consequence, did not call for replacement. Among the first-line capital ships our losses have been surprisingly light, considering the number of these vessels and the hazards they were compelled to run. Of the all-big-gun battleships, only two have been officially posted as sunk—the Audacious, destroyed by an internal explosion in July, 1917. In addition, three battle-cruisers, the Queen Mary, Indefatigable, and Invincible, have disappeared from the list, all three being sunk at the Battle of Jutland. New construction, however, has proceeded on such a large scale that, besides replacing these five vessels, we have an addition of five capital ships to the Grand Fleet.

Almost immediately after the outbreak of hostilities it was realized by those in authority that the naval campaign

would be of such a character as to necessitate the employment of special types of fighting craft in which the Navy was conspicuously weak. In the past our naval construction policy had been based on the supposition that the command of the sea depended, in the first instance, on the numerical and individual superiority of our capital ships. The principle was perfectly sound, and has, indeed, been abundantly vindicated in the course of the war, but in the opinion of some judges it was pushed rather to an extreme length in pre-war days. At all events, it is quite certain that our early operations were handicapped by the shortage of light cruisers, destroyers, and certain special types which had not been multiplied on a scale commensurate with the expansion of the battle fleet proper. Even before the submarine menace made its appearance, the demand for destroyers was greatly in excess of the material available; and when in due course the submarine danger became acute, steps were at once taken to accelerate the output of destroyers by every possible means. The time has not yet come to subject our naval policy since 1914 to a searching investigation, but it is permissible to observe that the Admiralty's decision to lay down a number of heavy battle-cruisers, monitors, sloops, etc., at a period when destroyers were the crying need, has been severely censured by critics of unquestionable authority. These larger vessels monopolized a great deal of labor, plant, and material, with the result that for some time the production of destroyers was seriously retarded. At a later date this policy was modified, and, on the whole, the output of naval material during the war has been eminently satisfactory. The private shipyards throughout the United Kingdom have in every case proved worthy of their great traditions.

The naval material completed since July, 1914, may be summarized as follows, the figures, though approximately correct, being quite unofficial: Eight battleships, five battle-cruisers, twenty light cruisers, 148 mine-sweeping sloops, sixteen large monitors, nineteen small and twenty-three river monitors, 190 destroyers and over 100 submarines. To the foregoing must be added many auxiliary craft, including whalers, "P" boats, large oil tankers, and 500 motor launches, the latter mainly of American construction. From the technical point of view, perhaps the most interesting, because the most novel, naval types built during the war are the so-called "hush hush" cruisers, a bold attempt to combine extraordinary speed with great gun power. We shall await with interest the revelations of how these mighty cruisers have acquitted themselves in service, and whether they have proved sufficiently useful to justify their high cost, not only in money, but in labor and material, at a time when both factors were almost priceless. As we pointed out last year, when M. Tardieu, a French naval critic, was allowed to publish a general description of their features, these ships complete a cycle of naval architecture which began forty years ago with the launch of the Italia and the Lepanto, when Italian constructors set the pace in the building of relatively huge vessels, with high speed, powerful armament, and moderate protection. As an indication of British shipbuilding and marine engineering capacity, the statistics relating to destroyers are very suggestive. Roughly speaking, we have completed one destroyer a week since August, 1914, in addition, be it noted, to a large programme of other construction, including nearly 150 sloops, numerous cruisers, monitors, submarines and auxiliaries, to say nothing of the mercantile production, which, despite the critics, has been very far from negligible. The magnitude of this shipbuilding achievement is enhanced by the fact that a modern destroyer is rarely less than a thousand tons in displacement, and has a speed of more—in some cases of far more—than thirty knots. The British shipyards and marine engineering ships have every reason to be proud of their war record. Hitherto, the public has necessarily been debarred by the censorship from learning what these allied industries have

done to maintain that naval supremacy to which, in the main, we owe the triumph of our cause. Now that the restriction on publicity is at end, it is fitting that their incomparable services should be made known and worthily acknowledged.—The Engineer.

Major Bond is Chief Engineer

Major F. L. C. Bond has been appointed Chief engineer of the Grand Trunk Railway System, with headquarters at Montreal. Major Bond, who succeeds Mr. H. R. Safford, recently appointed Engineering Assistant to the Regional Director of the Central Western District, United States Railroad Administration, has just returned from overseas, after two years service with the 10th Battalion Canadian Railway Troops. He was born in Montreal, in 1877, was educated at the Montreal High School, the Collegiate In-



Major F. L. C. Bond

stitute, and McGill University. Upon graduating from McGill, in 1898, he entered the service of the Grand Trunk as Assistant Resident Engineer of the Eastern Division, and in 1901 was appointed engineer in charge of double track construction. In 1902 he was night superintendent on the construction of the Park avenue tunnel of the New York subway, but returned to the Grand Trunk as Resident Engineer, Eastern Division, a position which he held until 1913. From 1913 to 1916, when he went overseas, Major Bond was Division Engineer, Eastern Lines, Grand Trunk Railway System.

The British Navy 99.99% Efficient

The statement was made on Trafalgar Day in London that the British Navy has carried, by means of its transports, 16,000,000 fighting men and the casualties amount to one man in every 10,000. The safety of the legions of overseas and American troops has rested with the Navy. That and the Mercantile Marine through their vigilance and efficiency have made the victories of the past years possible. They have fed and clothed the army in Saloniki and have kept England so well supplied with food and raw materials that no really serious lack has been felt.

A Diagram From Which May Be Readily Determined the Cost of Coal for Generating Steam

The accompanying diagram furnishes the power plant operator accurate information on the cost of coal for generating steam. Knowing the price and the amount of coal burned and the quantity of water evaporated, the solution is easy. Start with the cost of coal per ton and project vertically, intersecting the oblique line corresponding to the evaporation from and at 212 degrees F. being obtained from the boilers, then move horizontally to the left margin, where the cost of coal to evaporate one thousand pounds of water from and at 212 degrees F. is given. The chart can also be used to determine the evaporation required to generate steam at a certain cost, by reversing the above process. This chart should awaken interest in the relative efficiency of a mechanical stoker as compared with hand firing. The stoker shown in the illustration attacks Mr. Wasted Fuel from the following angles:

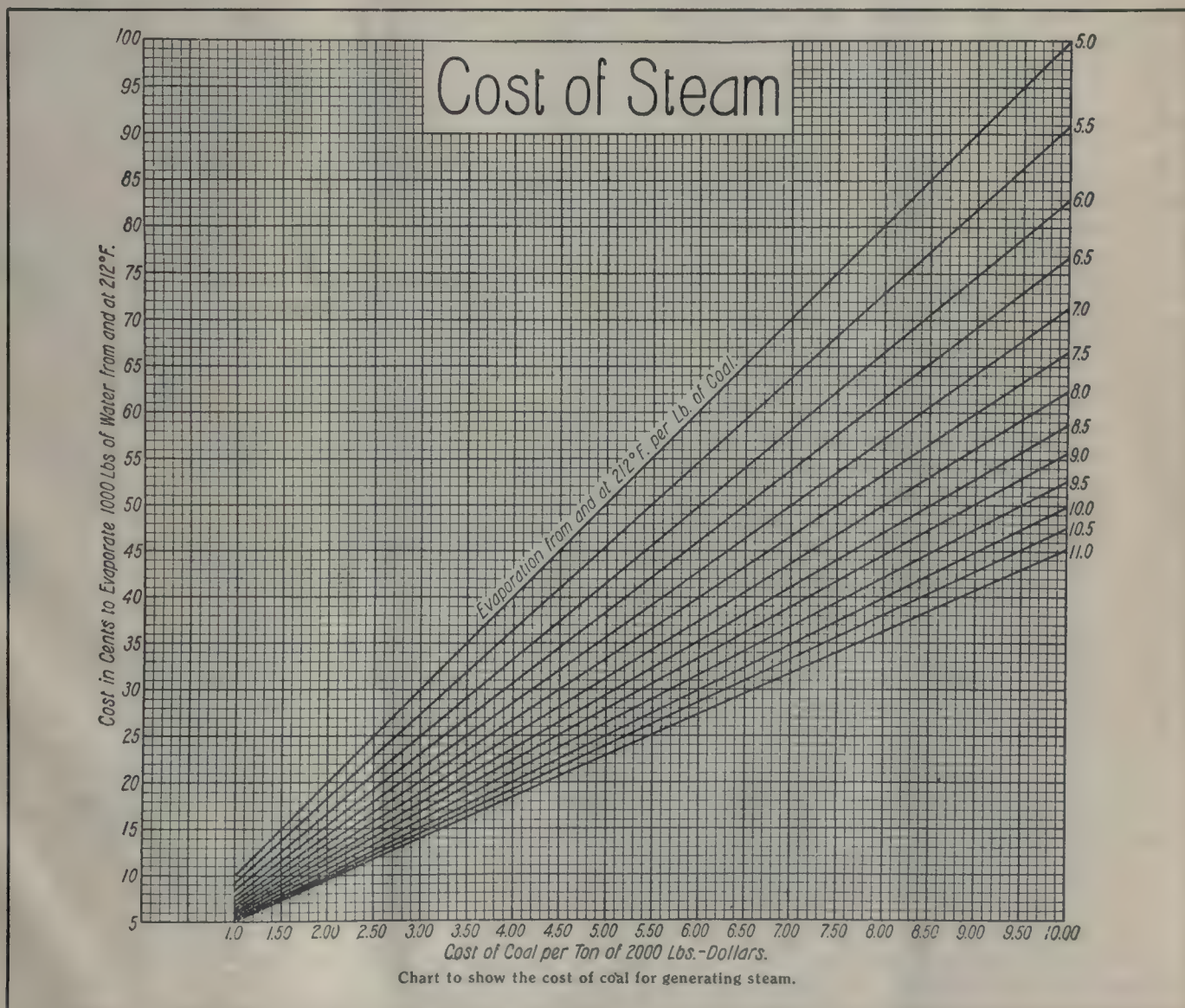
1. Smokeless combustion and a high percentage of CO_2 .
2. Volatile substances in the coal are distilled before they are introduced to the incandescent fuel bed.
3. A forced draft system of air control supplies the correct amount of air mixture at all times.
4. Carbon often wasted in the ash is burned before dropping the dumping grates.

Lignite to be Ready in 1920

The Lignite Utilization Board, composed of Mr. R. A. Ross, consulting engineer, Montreal; Hon. J. A. Sheppard, Moosejaw; and Mr. J. M. Leamy, provincial electrical engineer for Manitoba, has reported to the Council for Scientific and Industrial Research that there is a vast quantity of preliminary work to be disposed of before there can be any actual commercial output of briquetted lignite from the projected demonstration plant in Saskatchewan. Before proceeding with the purchase of machinery and the construction of the plant the Board estimates that six to eight months will be devoted to an exhaustive study of carbonizing and briquetting methods; six months will then be required for arranging plant lay-out and purchasing machinery, and six more months for commercial adjustment and initial operating stages. By the spring of 1920, therefore, it is anticipated the plant will be in full operation.

A Correction

In the article on the addition to the plant of the Tidewater Shipbuilders, Limited, Cap de la Madelaine, P. Q., in our issue of Dec. 18, page 1001, right column, 17th line, the text reads that the lines of the basin were set at one foot distance from the proposed wharf. This should read "one hundred feet."



Mainly Constructional

East and West—From Coast to Coast

The Manitoba Provincial Government proposes the erection of a home for the deaf and dumb at a cost of \$500,000. It is to be proceeded with as soon as plans can be completed.

The council of Outremont, P. Q., is considering a scheme for the erection of semi-detached cottages in blocks of from 25 to 30 at a time, to be sold on long term payments to prospective citizens.

The Brantford, Ont., Waterworks Commission has received approval from the Provincial Board of Health of the plans for the re-arrangement of its water purification system, which were prepared by R. S. & W. S. Lea, of Montreal.

A meeting was recently held in Winnipeg, Man., on Dec. 17th, at which representatives of many of the municipalities of the province were present, to discuss the offer of the federal government of financial assistance for house building.

It is proposed to add two wings to the Kingston General Hospital and to enlarge and modernize the facilities of the institution. The city has subscribed \$100,000 for the promotion of this work, and the Ontario Government is also being appealed to for financial aid.

The British Columbia Government proposes, as a means of relieving the housing situation, that municipalities deed over property acquired by tax sale, on which the Government may build homes to be sold to returned soldiers on long-term payments at a low rate of interest.

The Manitoba Government has been petitioned for the extension of the winter road constructed last year from Fort Alexander to Gold Lake. An engineer has been sent to survey the route and report on the cost and necessity of the work, which proposes carrying the road as far as Long Lake.

Still another deputation has interviewed the Ontario Government to influence, if possible, the decision as to the route of the Provincial Highway west of London. Elgin, Kent and Essex counties were represented and the merits of the southern route from London through St. Thomas to Windsor, were urged.

Mr. S. J. Crowe, M.P., Vancouver is recently quoted as stating that if the local interests which had the question of dry dock construction under consideration, did not make some definite proposition immediately, he would recommend that the government construct the dock, employing returned soldiers for this work.

The Ottawa city council has approved the appointment of a committee to discuss with representatives of the Dominion and Provincial Governments, and the Eastern Ontario Good Roads Association, the question of establishing a metropolitan road area surrounding Ottawa. The understanding is that if the metropolitan road area idea should be found impracticable, the committee will discuss the feasibility of creating a suburban road area.

The lowest tender received on the Peterboro bridge, over the Otonabee River, was that of the Canadian Engineering & Contracting Co., \$337,338, which, however, is nearly \$100,000 more than the \$245,000 voted originally by the rate-payers. Two other tenders were received: R. Sheehy, \$381,474, and John O'Toole, Ottawa, \$351,710. The cheques of the tenders were returned and the matter is to be left over for the 1919 city council to handle.

Work has recently been commenced in connection with the first six units of the big Calgary military convalescent

hospital, for which the Carter-Halls-Aldinger Co. has the contract at \$330,471. The hospital will be situated east of the present General Hospital buildings and, it is understood, will eventually revert to the city for general hospital purposes. The first six units will consist of three active treatment wards, a surgical building, an administration building and a service building. The latter includes the dining room and kitchen. The administration building will likely be completed first, though it is the intention to rush the whole set at once.

The council of Wentworth County, Ont., has passed a by-law incorporating the following roads in its county road system: Stoney Creek and Tapleystown road—from the southerly boundary of Saltfleet, between lots 8 and 9, between concessions 6 and 7, down the mountain and easterly to the Vine-mount station; Barton and Glanford town line—commencing at road between lots 14 and 15 and continuing easterly to road between lots 6 and 7; Wentworth street—from southerly terminal of Wentworth street, in Hamilton, to boundary of township of Barton; Garth street—from southerly boundary of Garth street, Hamilton, to road between concessions 7 and 8, Barton, and thence westerly to road between lots 20 and 21; Plains road—short piece of road about 1,600 feet from Toronto and Hamilton highway, northeasterly to the boundary of Halton county.

Obituary

Mr. Geo. Pounder, of the well known Stratford, Ont., firm of contractors, Pounder Bros., has become a victim of pneumonia, following an attack of the flu. Mr. Pounder had latterly been in Collingwood, Ont., in connection with the contract for the Bell Telephone Company's building, upon which work was commenced last May, and it was in that town he took ill and died. He was 39 years of age.

Mr. W. K. Greenwood, chief engineer of the Orillia Water, Light and Power Commission, Orillia, Ont., died on December 20, of Spanish influenza. Mr. Greenwood was a graduate of the Faculty of Applied Science and Engineering of the University of Toronto, in the class of 1904; a member of the Engineers' Club, Toronto; an Associate Member of the Engineering Institute of Canada; an Associate of the American Institute of Electrical Engineers and was well and very favorably known in engineering circles.

Mr. John Maxwell, of Fredericton, N. B., who for very many years had been a prominent builder and contractor in that city, passed away recently. Mr. Maxwell had reached a great age, having come to this country from Tyrone, Ireland, in the year 1858, at the age of twenty-five. He was connected with many large building undertakings, including the Marysville Cotton Mills, the Provincial Parliament Building, and the Provincial Hospital, at St. John. He also took a keen and active interest in civic affairs, and for a time was an alderman of the city.

Mr. Wm. J. Galbraith, a well known young Canadian engineer, died recently of pneumonia, at his home in Montreal. Mr. Galbraith was born at Lachine, thirty-two years ago, and took his B.Sc. degree in McGill University in 1909. Following his graduation he took up work in the geological survey in the Rocky Mountains, but in the fall of 1910 he joined the staff of M. P. and J. T. Davis, as assistant engineer on caisson work for the Quebec Bridge. In the spring of 1912 he went into business for himself as a contractor, and carried out a number of works, including a dock at Berthier, P. Q., a dam and power house at Walsdale Falls, Ont., and a wireless station at New Castle, N. B. Later he joined the staff of the Foundation Co., of New York, as superintendent of construction, and built shipyards at Victoria, Tacoma, Seattle, Savannah and New Orleans. Just before his illness he was engaged in the valuation of a shipyard for the Canadian Government.

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Education and Co-operation the Wisest Course in Dealing with Labor

UNDoubtedly the most important and difficult problem which faces industry at the present time is that of labor. And it seems to be a problem that will never quite admit of a permanent solution, since the factors that enter into it are legion and diverse. The advance of civilization, with its seeming reactions, and the uncertainty of human nature, are so involved with it that one cannot hope to accurately forecast its developments.

There are those, however, who do not seem to recognize the conditions which exist at the present time, who have been blind to the changes which have been taking place during the last few years. Some say there must be no "oppression of labor" and others, that "we must put labor in its place." As a matter of fact, there is now really no possibility of either oppressing or coercing labor. The reverse rather is true—that labor has it in its power to oppress and coerce, and neither capital nor the government can offer very effective resistance if labor's demands are beyond reason.

Of course a great deal will depend on labor leader-

ship, and, fortunately, the leaders in Canada, with a few exceptions, do not appear to be of the extremist type. The two foremost of them, Senator Gideon Robertson, the Dominion Minister of Labor, and Mr. Tom Moore, president of the Trades and Labor Congress of Canada, in addresses at a luncheon of the recent Ottawa Conference of Canadian Building and Construction Industries, displayed a friendly and co-operative attitude and a desire for better relations between employers and employed.

Senator Robertson declared that the reconstruction period should be approached by all classes of people having in mind that the future prosperity of the country depended very largely upon co-operation, with mutual respect for each other's rights. He attributed the industrial unrest which had arisen during the war, partly to the increased cost of living, which made it necessary that the workmen demand increased wages, and partly to the lack of united action by labor as a whole and employers as a whole. If both parties had been able to sit down trade by trade and work out agreements as to rates of pay and conditions of employment to be made effective throughout stated territory, he believed it would have contributed to efficiency and harmony.

The Senator also emphasized the importance of the housing question. If the situation were not relieved, he was afraid there would be considerable discontent among the returning soldiers and among workmen generally. The Federal and Provincial Governments, he declared, must take action, and should see to it that every workman who owned a lot and wished to build a home, should be furnished with the necessary money. It was his experience that a man living in any locality, who owned his own home, was generally a better citizen than the man who did not.

Mr. Tom Moore, the president of the Trades and Labor Congress, was strongly in favor of closer relations between employers and employed and a more democratic control of industry. He regretted that there had been no opportunity for the two parties to get together and confer, but he asserted that war had advanced the spirit of co-operation more than a century of peace, and that now the time had come for the abolition of autocracy in industry. Labor itself, he admitted—certain sections of it, in certain localities—had attempted to institute an autocracy. The danger lay in a sudden relaxation of restraint and a swinging to the opposite extreme, as had been the case in Russia.

In connection with the building industry, the particular difficulty was that it was so spread out and in so many hands, that it was hard to bring about the co-operation that was desired. The problem was greatly simplified when there was a concentrated organization on both sides. For this reason, Mr. Moore said he had always wished that the Builders' Exchanges should be numerous and effective and should have power to deal with the men employed in the industry. On the other hand, the employees' organizations should also be encouraged and recognized in the arranging of trade conditions. The only flexible feature in the building industry was labor, and as a result it had been the practice to make it the outlet by which loss was absorbed. The just and proper course, however, was to make the labor market inflexible for given periods.

Mr. Moore urged that employers should not foster organizations of a small local nature, as these had no power to discipline communities which broke their agreements. In national or international associations, however, if a community of workers breaks an agree-

ment and strikes, the larger body can demand that they go back to work or help the employers to find men to supplant them.

The great object and ideal to achieve, in the speaker's opinion, was the establishment of a more satisfactory and democratic control of industry than had existed in the past. The workers, he asserted, who put money in their homes and helped to build up their community, were often bigger investors than the employers, and should therefore have a voice in the management of the industry to which they belonged.

If we may judge labor's aims from the tone of Mr. Moore's remarks or Senator Robertson's, they are certainly not unreasonable and indeed are commendable, but it is regrettable that the methods which the unions adopt to attain these objects are sometimes the reverse. They arbitrarily seek to create a new heaven and a new earth over night, so to speak, and, on occasion, have not hesitated to use the weapon of the strike to enforce demands which are unjust and oppressive. An organization which professes to be socialistic cannot refuse to submit its demands to arbitration without a virtual renunciation of its principles, yet on more than one occasion the unions have been guilty of this apostasy.

There is also a Bolshevik element which, though undoubtedly it is a small minority, is sufficiently strong to be dangerous. In the Labor Temple in Toronto, a number of this persuasion at a recent meeting gave three cheers for their Russian brethren who have upturned the state and taken the government upon themselves, regardless of all other elements of the population, with the result that the country is in the throes of a moral, political and economic convulsion. Also there has been some outspoken defence of the Bolsheviks from public platforms, and revolutionary pamphlets have been distributed on the streets of our cities calling upon labor to arise and throw off the capitalistic yoke.

These may sound like alarmist reports, but they are facts and we cannot afford to disregard them. There is, perhaps, no real cause for anxiety, but there is need for action. These extremists cannot be allowed to continue their dangerous propaganda, which undoubtedly will find fruitful soil in the alien population that forms so large a percentage of our common labor. To talk of freedom of speech when attempts are being made to cause discontent, and even revolution, in a democratic country, is utter folly. The Government must take action to suppress all Bolshevik tendencies.

But we must not antagonize the saner majority of organized labor. The unions may become a curse and a menace if their enmity is aroused, but by diplomatic handling they may be used as a means of raising the standard of the working class and of educating the alien immigrant in the ideals of Canadian citizenship. We cannot agree with those who refuse to recognize the labor organizations—the responsible ones. It is like closing one's eyes to the inevitable, for the tendency towards organization is too strong to combat—even were it wise or just to do so—and we must either follow the course of education and conciliation, or of incessant conflict and controversy. Is it not safer to try and use the unions than to antagonize them? Let us, if possible, foster responsible organizations, whose agreements will be something more than scraps of paper. Labor is seeking a place in the sun, deserves it, and will have it by fair means or foul. The best policy therefore seems to be the suppression of the extremists, but recognition of, and co-operation with, the sane majority in organized labor.

The Value of a Photographic Record in Construction Work

PHOTOGRAPHS taken during construction and after the building is completed furnish a record of work accomplished that cannot be secured in any other way. A log book of every job is kept by the majority of contractors, but have you ever considered what a valuable supplement a series of progress photographs would make to your record of the work? It is an indisputably authentic record that has been recognized and accepted by our law courts on several occasions, when legal tangles have unfortunately cropped up, and has often been the means of saving the contractor trouble and financial loss.

A good photographic reproduction of a well constructed building or other contract you have successfully handled, may often influence an owner in the awarding of a contract. At any rate it is substantial proof of your ability to successfully carry out a contract, proof that might otherwise be difficult to bring to the attention of those interested.

A progress photograph taken at the end of each month could be submitted to the architect or engineer when application is made for a certificate. This photograph, showing, as it will, the work completed to date, will be of assistance to the builder in securing for him the maximum payment possible for the work completed.

To be of the greatest value a construction photograph must conform to certain rules. A standard size should first be determined and then no departure made from this standard. From 8 x 10 inches down to 5 x 7 inch films or plates have been found to be very satisfactory for this class of work.

To get uniformly good results all photos should be taken by an expert photographer. Don't depend on amateur snapshots. Sometimes they are very satisfactory, but generally they are failures and these failures reduce the value of this kind of record considerably. The cost will not be great compared to the value received.

Progressive construction photographs should always be taken from the same points. A point should be selected which will give a three-quarter front view and should show at least a part of the side of the building. The best time to take an exterior picture of this kind is usually when the shadows are fairly prominent, so that brick work, door openings, etc., are accentuated. Whenever possible, there should be one person in the picture to serve as a scale of size. Telegraph poles should be avoided, but trees covering a small part of the building are not objectionable. A margin is necessary to serve as a background. In taking interiors, a view straight down the centre of the building is preferred, unless columns interfere; the camera should be slightly to one side of the centre and at least 20 feet from the nearest column.

Every print should bear the date of taking, as well as the title. It might be well to have this marked on the margin of the negative. A print of each negative should be pasted in or otherwise attached to the log book of the job, which is, or should be, entered up to date each night. This will form a permanent and authentic record of each job.

Railroad tunnels under the Straits of Dover and Gibraltar are projected as part of English and European reconstruction. Plans have already been prepared, it is stated.

Rideau River Intercepting Sewer, Ottawa

By L. McLaren Hunter, A. M. Inst. M. & C. E., City Engineer's Dept.

THE Rideau River Intercepting Sewer is located in the southern district of the city and extends from Somerset Street in St. Georges Ward to Windsor Avenue (Ottawa South) in Capital Ward. This is a distance of 17,900 feet. It was constructed to drain a portion of Ottawa South and to give a greater depth for house drainage in other portions of the same district. It will also drain a part of Ottawa East.

The city engaged the well-known firm of consulting engineers, Messrs. R. S. & W. S. Lea, of Montreal, to make a report on the necessity for and the design of the interceptor.

In designing the interceptor it was important to

Area "I"—Including 400 acres above the Cameron Street outlet.

Area "II"—Including 180 acres between the Cameron Street and Clegg Street outlets.

Area "III"—Including 20 acres between the Clegg Street and Brunswick Street outlets.

Area "IV"—Including 80 acres lying along the Rideau River between the Ottawa East district and the area tributary to the Somerset Street main sewer, viz.:—Area "D."

The present main sewer has its outlet in the Ottawa River at Edwards Mill, at the foot of John Street, and crosses the canal at Somerset Street, where the Rideau River Interceptor commences.



Map showing alignment and drainage areas
—Rideau River Interceptor.

adopt such a route and grade as would permit of its convenient incorporation in the main drainage scheme which must be provided eventually for the whole city of Ottawa and suburbs.

The area of the section drained is 1,060 acres, 36 per cent. of which (380 acres in the Ottawa South and Ottawa East districts) is already sewered on the combined system. Fig. 1 shows the sewered and unsewered areas. The former is referred to by letters and the latter by Roman numerals.

It will be noted that Area "A" includes 180 acres in Ottawa South, with an outlet at Cameron Street. Area "B" includes 45 acres in Ottawa East with an outlet at Clegg Street and Area "E" includes 155 acres in Ottawa East with an outlet at Brunswick Street. The unsewered areas are as follows:—

The first section was constructed of segment tile 60 inches in diameter, running from Somerset Street to the Gas Company's property. The next section, of 54-inch pipe (part segment and part concrete pipe) runs from the Gas Company to Clegg Street. The section from Clegg to Windsor was constructed of 48-inch concrete pipe—(this is being continued along Windsor to Bank and Grove street and is called the Ottawa South sewer extension, although really an extension to the Rideau interceptor). A 30-inch concrete pipe is carried along Cameron to Leonard. This extension is 4,000 feet in length. The extension of the interceptor is shown in heavy dotted lines in Fig. 1.

Work was commenced in December, 1915, by day labor, under Foreman J. J. Sullivan, a concrete bell-mouth being built, 60 inch off 84 inch, at 40 feet radius,

to connect with the main drain. A gang of seventy-two men were employed during the winter of 1916-17 and rapid progress was made.

The gradient for the whole length of the interceptor was 1 in 1,000, three crossheads being used every 100 feet for sighting purposes.



Fig. 2. Profile of Tunnel Section

The most interesting part of the work so far was the tunnelling operations carried out in 1916 under the Canadian Pacific and Grand Trunk railway tracks. This tunnel was commenced just northeast of Hurdman Road and was carried across the tracks for a distance of 400 feet. Fig. 2 shows the profile of this tunnel, the average depth below ground level being 24 ft. A night and day gang were kept constantly at work on the tunnel, the progress made being 6 feet per shift. Four men were kept laying the tile and two digging ahead, six men in all composing the gang.

In Fig. 3 is shown the style of tunnel drum used. This was constructed of boiler plate rivetted together and braced by L iron, the "peak" (or the 8 ft. end) being placed where the "mucking" operations were carried out. This peak allowed plenty of space for the laying of the tile behind. The drum was driven ahead by screw jacks as the "mucking" operations progressed. For most of the way the tunnel was pushed through

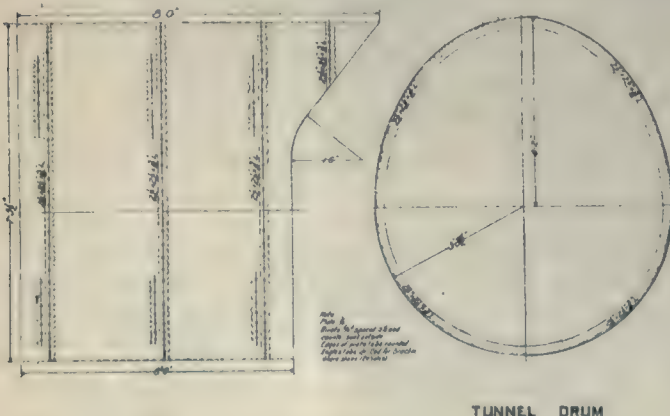


Fig. 3. Tunnel Drum

hardpan and river clay. At one portion, however, quicksand was struck and there an air blower was used which stiffened it sufficiently to allow the work to be proceeded with. This section from Somerset street to Hurdman road had an underdrain laid 9 in. in diameter.

The Lees Avenue section was constructed of 54-in. tile during 1917. Quicksand was found most of the

way and truss braces had to be used for holding up the bank. Double sheeting and the wood haunches had to be left in the trench.

The tile for the 60-inch and 54-inch sections was supplied by the Natco Tile Company at a cost of \$5.65 per lineal foot.

When about a quarter of the work was done on the 54-inch section Commissioner of Works Macallum decided to call for tenders for reinforced concrete pipe. The tender of B. Blair & Co., of Woodstock, Ont., was accepted, at \$4.34 per foot for 54-inch pipe, and \$3.44 per foot for the 48-inch pipe. This meant a saving of \$1.92 per foot for the 54-inch pipe and \$3.41 per foot for the 48-inch pipe. This step taken by the Commissioner saved the city \$19,000,—\$15,400 in the cost of pipe and \$3,600 in the cost of laying it.

By the end of 1917 the work had been carried as far as Main street, next to the Williams property. Further progress was delayed by a disagreement between the city and Mr. Williams over the price of a strip of land where the sewer was to be built. This dispute



Fig. 4. Tunnel Drum

was settled in July, 1918, and the work was recommenced in August.

The work of conveying the pipe from where the contractors had dumped them caused delays and entailed a great deal of expense. At first a track was built and a light carriage made. This was drawn by horse to the derrick but the lifting and laying of track always delayed the work of pipe laying for several days. The difficulty was overcome by providing two wheels which were inserted into the pipe and tightened by wooden wedges; through the centre was a 2-inch steel spindle which protruded about 9 inches past the edge of the pipe on both sides; a team was hitched to this and the pipe drawn to the job like a large roller. With this device there are no delays in pipe laying, the work going on steadily day by day. The highest record reached in pipe laying was 124 lineal feet, the average being 72 lineal feet per day of nine hours.

It has been decided to push this work ahead during this winter in an endeavor to finish it by next August.

To cheapen the cost of excavation during the winter months when the frost has penetrated deeply into the ground a box has been built, as shown in Fig. 8;

this is laid each night about 60 feet in length (sufficient for a day's work). Into this box a 2-inch steam pipe is run, perforated every 18 inches, and steam is kept on at high pressure. In the morning the ground has thawed out and digging is comparatively easy.



Fig. 5. 60 in. Natco Lock-Joint Sewer. View on Robinson Ave. section

To keep the fresh cement in the joints from freezing two brick heads are placed in the interior of this pipe where the cement is still green and steam is kept circulating between them.

Fig. 9 shows the method of supporting the pipe which was used on a stretch of 250 feet where the pipe was practically on the surface of the ground.

The following is a list of some of the larger equipment used during construction:—1 45-h.p. boiler

(steam), 1 40-h.p. boiler (steam), 1 derrick and 1 traveller, 3 syphons, $\frac{1}{4}$ in. submerged pump (electric), 1 4-in. suction pump (electric).

The costs of various materials used are as follows:—

1917—54-in. concrete pipe	\$4.34 per ft.
48-in. concrete pipe	3.44 per ft.
1918—48-in. concrete pipe	4.30 per ft.
30-in. concrete pipe	2.35 per ft.
1917—60-in. Natco tile	5.65 per ft.
1916—Cement	.43 per bag
1917—Cement	.52 per bag
1918—Cement	.73 per bag

On the 60-inch Natco tile section in 18 feet of excavation the costs were as follows:—

	Lin. Ft.
Excavation and backfilling	\$ 8.240
Pipe laying	.375
Natco tile, including underdrain	7.427
Pumping	.766
Shoring	.652
Grading plant, sundries	1.744

Total cost per lin. ft.	\$19.204
Tunnel section (excavation) . . . per ft.	\$19.37
Manholes (concrete) each	61.46



Fig. 7. Back fill over pipe.

The cost of 48-inch concrete pipe section in 4 feet 6 inches of excavation this year was as follows:—

Labor

	Lin. Ft.
Excavation	\$1.37
Shoring	.68
Pumping	.20
Backfill	.60
Culvert drains (draining property)	.16
Rolling pipe	.29
Running hoist	.33
Derrick and track	.44
Grouting	.12
Pipe Laying	.34
Sundries (including Saturday afternoon holidays for laborers)	.58

— \$5.11



Fig. 6. Shallow cut through Williams' property. 48 in. Concrete Pipe being lowered. Pipe conveyor on rails at left.

Material	
Pipe (including hauling)	3.60
Coal	.24
Cement	.11
Sundries	.11
	\$4.06
Total cost of interceptor per ft.	\$9.17

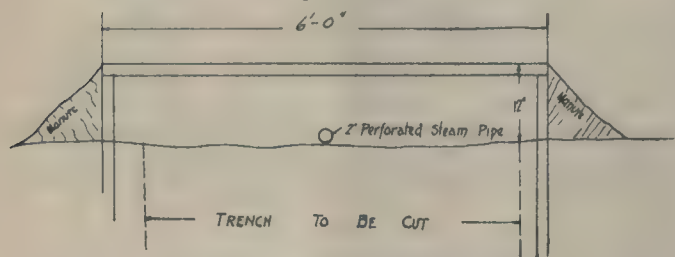


Fig. 8. Method of softening frozen ground

The above costs on the 48-inch section were taken on 400 lineal feet of work which was done in August, 1918. On the Williams property laborers were being paid 35 cents per hour. On this section and on the Natco tile section 1916 laborers were being paid at 27½ cents per hour.

The whole of the construction work was done by day labor, the assistant engineer in charge to Main street being W. F. M. Bryce (now overseas), the writer taking his place and is carrying the work to completion. Mr. F. C. Askwith supervised the work from the beginning and latterly Mr. A. F. Macallum, the Commissioner of Works.

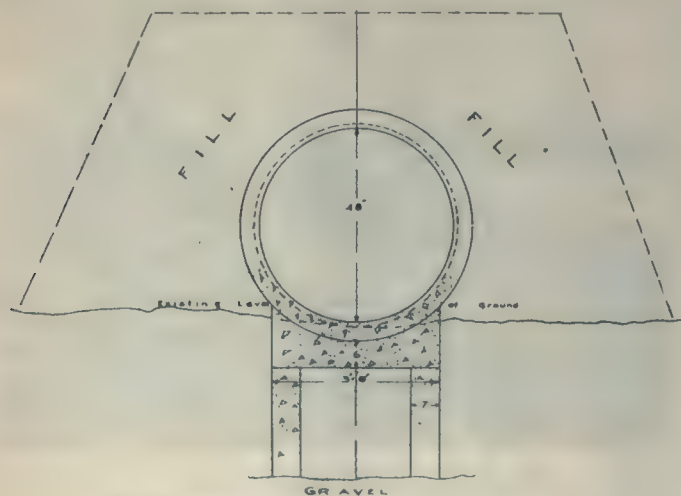


Fig. 9. Method of supporting pipe on low lying ground

The Rideau interceptor will cost \$300,000 and the extension to the interceptor \$50,000, making in all a total of \$350,000.

When this work is finished another drainage scheme will require to be commenced for that part of Ottawa south west of Leonard and south of Cameron. This will be built in the separate system, the surface water being drained into the river and the sewage pumped into the present interceptor at Leonard and Cameron. Preliminary surveys and levels are at present being made for this.

The city have expropriated a strip of land along the whole bank of the river where the interceptor is laid; this strip averages 50 feet in width. The intention is to build a new driveway later on to connect up with the Federal Government's driveway system.

Don't Wait For Spring Before Starting Proposed Government Programme

WE trust it is the intention of the government to proceed with its proposed construction programme immediately. We have been assured that the work will be proceeded with, but is it the intention to wait until spring before getting under way?

Granted that some kinds of construction have to be reduced or discontinued with the approach of cold weather and short days, there are other kinds of construction that are not seriously influenced by these conditions. For instance, rock work, tunneling, grading, excavating, dredging and many other important operations can be carried on almost as well in cold weather as in warm, and will furnish considerable employment and keep the contractors' forces and equipment busy. It is also possible to carry on concreting except in excessively cold weather, by observing simple precautions and protecting the work at a cost often more than justified by avoiding delay. Wherever concrete is to be placed under water the only extra precaution to be observed is to keep it warm from the mixer to its destination.

Our men are returning from overseas at a rate that makes one wonder where the immediate employment is to be found for them. They must be provided for and it would appear that this is sufficient justification in our again urging the authorities at Ottawa to lose no time in getting some of the proposed work under way.

Arising out of the controversy over the construction of the Lasalle Bridge, Montreal, two contracts for which were abandoned by contractors, Messrs. T. O'Sullivan, A. Pion and F. A. Grothe, contractors, of Montreal, will apply at the next session of the Quebec Legislature for an act modifying the agreements made between them and the city of Montreal for the building of the bridge and to have their deposit, with interest, the value of their equipment and materials and labor supplied by them, reimbursed and paid by the city of Montreal. The contractors also ask to be indemnified for the losses they have incurred in the performance of their contract and for other purposes.

During the past year building operations in Montreal, as indicated in the civic permits, were ahead of 1917, this being the first year that construction has shown an advance since 1913. The total amount for the year, including repairs, was \$4,882,873, an increase of \$494,835. Of the total for last year \$3,591,665 represents new work, and \$1,291,208 repairs. Except for factories there were no large buildings of any outstanding importance erected during the year. The ammunition work was responsible for a considerable part of the new factory construction: 47 new factories were erected and 31 old factories repaired. The small amount of building in houses may be judged from the fact that only 269 were erected. Six new schools were put up and 4 repaired; there were 121 new garages and 40 new stores.

At Columbus, Ohio, is the highest tower for pouring concrete on record. From a distance it looms up like the Washington monument. The tower is part of an equipment that is to be used in making Columbus safe from floods. It is 175 feet high and built entirely of wood.

The Pneumatic Method of Concreting

By H. B. Kirkland*

THE pneumatic method of mixing, conveying, and placing concrete is a comparatively recent development in engineering methods of construction. This method should not be confused with the Cement Gun process, which is a plastering process, and is entirely different in operation and purpose. Both methods are patented. The pneumatic method is adapted for heavy, difficult concrete work, using ordinary ingredients with aggregates up to 4 or 4½ inches in diameter.

Briefly described, this method consists simply in blowing batches of concrete through a pipe from a central point of supplies to their place in the concrete forms. The materials for a batch of concrete (½ cu. yd.) are proportioned in a measuring device and dropped into the pneumatic mixer without previous mixture.

The plant for pneumatic mixing and placing consists of (1) a mixer, (2) a pipe-conveying system, and (3) a compressed air plant.

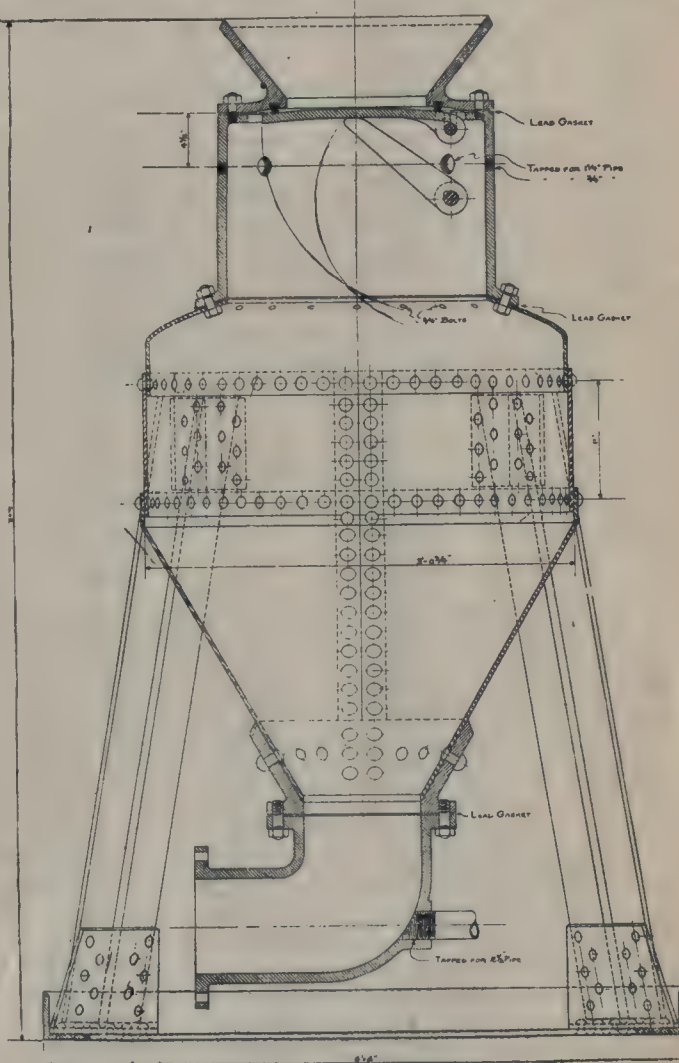
The Mixer.

The mixer consists of a steel shell having the shape of an inverted cone surmounted by a cast steel cylinder in which the door operates. The door is operated by a small air piston which closes the flap door. The door is opened by releasing the air in the cylinder, allowing the door to drop open by its weight. At the bottom of the inverted cone chamber is a 90 degrees elbow which forms the connection to the discharge pipe. The door and piston is the only moving part of the mixer and the inside contains no mechanical mixing apparatus and is entirely smooth and free from obstructions. The main air jet is located at the heel of the bottom elbow of the mixer. This jet is the main means of conveying and mixing the concrete. It is supplemented by air jets located at top of the mixer. The main air jet is directed into the center of the discharge pipe where it catches the material as it falls from the cone shaped hopper above. The upper air jets create a pressure from above the batch, forcing it downward into the discharge pipe where it is caught by the main jet. To admit air to the mixer, two valves are used, one detaching successive portions of batch at the tip of the cone. The materials in the mixer flow downward in the same manner that sand flows from the upper chamber of an hour-glass, but the speed of the flow is accelerated by the air pressure.

The Conveying Pipe.

The conveying pipe consists of any standard smooth steel pipe with joints made with bolted flanges or any type most easily and rapidly handled in making connections. The most rapid wear on pipe occurs at the joints where there is apt to be a slight irregularity or a shoulder. Threaded pipe is also thinner where the threads are cut and, of course, wears through there first. For this reason we have used several types of joints and the Van Stone joint is about the best. This is out of the question now—in war times—however, on account of the cost of anything not of standard make, so we have found it cheaper to use standard pipe with bolted flanges screwed on. For making de-

flections of the pipe line, cast elbows are used. An ordinary cast iron elbow will last sometimes less than a day, but a case-hardened steel elbow will usually last a few weeks. The best elbow I have found to be a cast manganese, which will almost outlast the pipe itself. We have made these els in 45 degrees with a thickness of ⅝ inch on the inner curve and ⅞ inch thickness on the outer curve. This gives a weight of about 220 lbs. for an 8 inch elbow and we have, therefore, not made them longer than 45 degrees. The radius of the el is 3 feet minimum, as a shorter radius



Section of Half Yard Pneumatic Mixer

is too sharp a turn and causes plugs in the line. Shorter radius els may be used, however, if used at the discharge end of the pipe. We have also used a split elbow of 90 degrees for 6 inch pipe. This el is split lengthwise so that the outer half of the curve which usually wears rapidly may be replaced.

A means of deflecting or guiding the discharge of concrete in the forms consists of a series of slightly tapered pipes, fitting together like stovepipe. Two or three sections of this light pipe about three or four feet long are all that are needed in a tunnel form for diverting the discharge from one side wall to the other and for guiding the concrete discharge around points

*President and Chief Engineer, Concrete Mixing and Placing Co., Chicago, before Western Society of Engineers.

of rock projecting from the roof. Where the tunnel is very wide, however, as in a double track railroad tunnel, we have used a "Y" branch in the line, thus separating the line into two lines of pipe entering the tunnel form. A slide valve or gate is placed in the "Y" for diverting the batches through one line or the other.

Compressed Air Plant.

A suitable type of compressor and the one usually employed in a straight line, one or two stage machine compressing from 80 to 125 lbs. The motive power may be steam, oil or electricity, as is most economical under the conditions prevailing. When possible, it is desirable to locate the plant near the mixer, but it is necessary to provide air storage close to the mixer, sufficient at least, to store enough air to discharge a batch of concrete at the maximum distance required. This storage should be at least 100 feet capacity, with 30 cu. feet capacity added for each 100 feet of pipe line. There should be additional storage at the compressor if the mixer is located a considerable distance away (for example, more than 300 feet away).

The amount of air required to convey concrete depends upon the specific gravity of the materials, the smoothness of the pipe, the number of bends in the pipe line and their radius, the distance conveyed vertically and horizontally, and upon the pressure or velocity of the air used. For the standard size mixers the amount of air required is 2 cu. feet of actual free air compressed to 100 lbs. per square inch per lineal foot of pipe per batch. In other words, to convey one batch 500 feet it will take 1,000 cu. feet of actual free air compressed to 100 lbs.

Based upon this figure, I have drawn a curve to show the amount of air required to convey concrete at various distances. This curve is based upon practical observations on a number of jobs, and certain assumptions have also been made in order to complete the figures. I have assumed in this curve certain conditions of the concrete operations as follows: twenty seconds are allowed for opening the door and charging the mixer after each batch has been discharged and the air valves closed; five seconds are taken as the length of time to convey each batch 100 feet, and as the distance becomes greater the number of batches per hour decreases until with 2,500 feet the number is 24, and the amount of air at this distance is 2,000 cu. feet per minute. It should be borne in mind that if it is desired to get the maximum output possible, the capacity of the compressor should be great enough to build up the air pressure in the storage tank in the time required to shoot a batch. Thus, if the distance is 1,000 feet, it will require 2,000 cu. feet of free air compressed to 100 lbs., and the time required to shoot the batch will be 50 seconds plus the time required for loading the next batch (20 seconds), or a total of 70 seconds. This requires, then for a maximum capacity of operation, a compressor which will provide 2,000 feet of air in 70 seconds, or 1,700 feet per minute. It should be borne in mind also that we are speaking of actual air and not of compressor ratings. A 600 foot compressor will produce actually about 480 feet of free air or 80 per cent. of its rating.

One of the first questions asked by the engineer is, "How is the concrete mixed?" This is explained by making a study of the conditions which affect the batch from the time it is placed in the mixer until it is delivered in place in the forms.

In loading the mixer the ingredients, cement and water are usually placed in a measuring hopper so that

when the hopper is emptied into the mixer the first commingling of the ingredients takes place. This first commingling is not particularly important, as it is very slight. When the air is turned on that portion of the batch, which is at the bottom of the mixer, in front of the conveying air jet, is first to move and is instantaneously followed by portions dropping from above. As the mixer has the shape of an hour glass, the central portion of the batch in the mixer flows down first, and the portion in the sides follows in the stream from the upper part, exactly as sand flows in an hour glass. During this operation the mingling of the different ingredient parts causes the smaller ingredients to flow into the voids between the larger ingredients. As the portions of the batch drop into the lower air stream, which has a velocity of about 5,000 feet per minute, these portions are carried along in suspension much as dust is carried along in a storm, except that the particles are much closer together. Although the speed of the air jet is very high, the speed of the concrete materials is much slower. The speed of the concrete varies according to the amount of voids in the materials which permit the air to pass through. The air in passing through the voids tends to carry with it the smaller ingredients; that is, the sand tends to fill the voids between the rocks and the cement tends to fill the voids remaining, and, as the voids become filled up with the smaller ingredients passing through, the speed of the mass increases, the pressure of the air behind the mass increases with the decrease of the voids in the mass, and the speed of the mass concrete increases.

Now, in this explanation of the mixing process, I have assumed that the air velocity passing through the pipe is sufficient to keep the materials in suspension, and it is important to have a sufficient air pressure to keep the materials in suspension, because when the air velocity is reduced the materials simply roll and tumble along the bottom of the pipe. The concrete will also mix in this manner, but it is not conducive to good operation and make a dirty pipe line, which is liable to become plugged. In shooting concrete, therefore, it will be found that with an 8 inch pipe and with materials of the specific gravity of limestone, the pressure should not fall below 50 pounds, as the materials will then commence to drag along the pipe. Any air expended below 25 pounds is wasted when blowing concrete through an 8 inch pipe.

• Examples of Work.

Three general types of pneumatic installations have been developed through the requirements of different classes of work. There are (1) Central plant or scheme of locating the mixer at a central point from which the conveyor pipe is laid to the forms, (2) Portable plant or outfit upon which the same mixer is carried and is either loaded from bins carried on the same conveyance or supplied by a belt or other loading device, and (3) the scheme of loading the mixer at various points as at the bottom of manholes in shallow tunnels and supplying it with materials through a chute from the various corresponding points along the surface. The last is a form of central plant made semi-portable.

One of the jobs done under the first scheme was the construction of piers for the Otis Steel Plant, at Cleveland. The mixer was located under the bins which were filled by clam-shell buckets handled by a locomotive crane. From the mixer an 8 inch line was laid to the various sections of the area, giving a maximum conveying distance of 750 feet. The piers were from 12 to 18 feet in length and contained from 10 to 19

cubic yards. The gooseneck delivery end was built to elevate the concrete above and into the forms and this was moved about on rollers from one pier to another. It contained a swivel joint permitting it to be placed so as to reach four piers at one setting. The plant contained one $\frac{1}{4}$ yard mixer and was supplied with air by a motor-driven 600 cu. feet Ingersoll-Rand compressor.

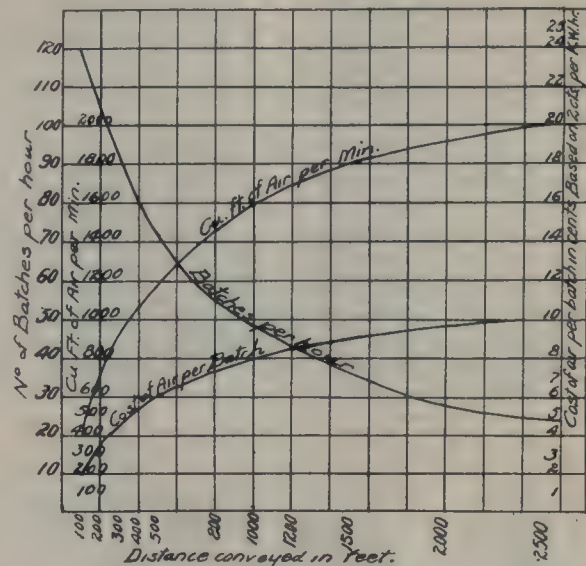
Another interesting job of this type of plant was the lowering of the West end of the Van Buren street tunnel, in Chicago. This tunnel carries a double track street railway under the Chicago River, and under the tracks of the Union Station. The tunnel grade was lowered about 15 feet, and a new section, slightly less in width than the old tunnel, was designed. First the side walls and roof of the new tunnel were built, but instead of being carried down to their proposed depth in the first construction operation, these walls were built to the level of the old tunnel floor or invert and then the new roof was built upon them. Afterward the new side walls were extended down to the new level by underpinning. Alternate 10 feet sections of wall were excavated and filled with concrete down to the depth of the wall, and the remaining 10 feet sections were excavated and filled after the first sections had been completed. After the walls were carried down to the new level, the core of earth was excavated and the concrete invert constructed, thus completing the tunnel section.

Inasmuch as the section of tunnel which was lowered was only 700 feet long, it was possible to locate the pneumatic mixer with bins above it at about half way between the ends of the work, thus making the maximum distance which it was necessary to convey concrete about 350 feet. This central point was at the old tunnel portal. Bins were located here over the mixer and the top of the bins came to the level of the street, so that materials brought in motor trucks were dumped directly into the mixer. An air receiver of about 120 cubic feet capacity was located near the mixer and air was supplied by a Sullivan angle compound motor-driven air compressor, belt connected. The compressor had a rated capacity of 628 cubic feet of free air per minute.

Another interesting piece of work was the lining of the Chain of Rocks tunnel, which is an 8 foot tunnel under the Mississippi, north of St. Louis. The tunnel was excavated in limestone, was 2,700 feet long, and 8 feet in diameter. A shaft was sunk on the shore of the Mississippi 96 feet deep at a point 500 feet from the land end and 2,200 feet from the crib end in the river. The pneumatic mixer was set at the bottom of the shaft and a hopper for measuring the batch was built at the top of the shaft. The land section of the tunnel was first concreted. Work was begun with a line of 8-inch discharge pipe about 470 feet long, extending along the tunnel to the forms. The forms are built of structural angles and channels with wooden lagging and light sheet metal nailed to the lagging. The forms were portable and were carried on two small trucks running on a narrow gauge track placed on the invert. The forms are 36 feet long and are provided with screw jacks built on the trucks for lowering and raising and with turnbuckles which are used to pull the wings in laterally to provide clearance when moving the forms.

The forms were first set up about 50 feet from

the end of the tunnel and the pipe from the mixer was run through them to carry concrete for placing the invert. After this section of invert was placed the forms were pushed back over the completed invert and were made ready for concreting the arch. A heavy bulkhead, placed at the rear, was reinforced with sand bags. The concrete discharge pipe was laid along the tunnel from the machine to within 20 feet of the forms and here a $22\frac{1}{2}$ -degree elbow was inserted and then a 20-foot length of pipe was added, which brought the pipe up to the roof of the tunnel, where another $22\frac{1}{2}$ -degree elbow was placed in the



Curves showing amount of air required to convey concrete at various distances

line, then a straight piece of pipe about 18 feet long was added, which carried the end of the pipe over the top of the form to about the middle point of its length. The front bulkhead was made by bolting a 9-inch board to the forms and then as the concrete began to fill up, sand bags were laid to complete the bulkhead and to fill up the irregularities between 9-inch board and the rock.

The concrete, in discharging from the pipe at a velocity of about 100 feet per second, is discharged against the back end of the arch, where it flows down over both sides and assumes about a 30-degree angle, sloping forward. When the form is filled so that the arch is within a foot or so of the pipe, the last section of the pipe is removed so that the end of the pipe is then projecting just through the bulkhead and the balance of the section is completed. The concrete is blown in until the concrete is within a foot of the pipe and this last portion of the arch may be filled nearly full by discharging a small batch of the proper volume. The usual practice, however, is to move the forms forward until it just overlaps this little cavity.

Women are to assist in the planning of the homes which the British Government proposes to build as part of the plan of national reconstruction. The Ministry of Reconstruction has formulated a scheme for the erection of some 300,000 workers' cottages, and a Women's Building Committee has been appointed in connection with it to advise on the interior planning of these houses.

Steel Bridge Replacements on the Sydney Subdivision of Canadian Government Railways

By Mr. A. H. Jones*

TO take care of the heavy power which the management desires to operate on the Sydney Subdivision of the Government railways, the work of replacing sixteen steel bridges and viaducts on the line between Point Tupper and Sydney was undertaken by the Engineering Department in 1915, and is now nearing completion.

This branch of the Government Railways was constructed in the year 1887, and the bridges are consequently of a lighter design than the present-day requirements, and are not strong enough to carry the heavy engines which it is now necessary to operate in order to economically handle the great amount of freight going to and from the Sydneys in connection with the large steel works, coal mines and other industries at these points, and also for transshipment by boat to Newfoundland and other points. It has consequently been necessary for some years past to place speed restrictions on nearly all the steel bridges on this Subdivision, resulting in a slow schedule and a loss of much valuable time.

It would be impossible to give anything here but a very brief description of the more important part of this work. Eight steel bridges have been replaced with heavier spans during the past year (including the big bridge at Grand Narrows), necessitating in most cases quite extensive alterations to the old masonry abutments and piers. Two steel viaducts have been entirely replaced with steelwork of a heavier design, on new concrete pedestals and abutments, viz.: Ottawa Brook and Walker's Gulch. Five steel viaducts were down for filling in, and this work, which was started late in the fall of 1915, has been mostly completed. This extensive bridge replacement work (involving an outlay of approximately three-quarters of a million dollars), will make it possible, when completed, to remove the speed restrictions from all these bridges, and during the past year we have removed the restrictions from ten bridges.

The most interesting part of this work was, per-

*Engineer, Canadian Gov't Rys., Moncton

haps, the replacing of the old spans of Grand Narrows Bridge with heavier ones. This bridge, which is across the Narrows between the Big Bras d'or and Little Bras d'or Lakes, is one of the objects of special interest to tourists on this section of the Intercolonial Railway. It is 1,697 feet, or nearly one-third of a mile long, and consists of six through-truss spans, each 242 feet long, and a swing span at the east end, of



Masonry Alterations, Bridge Over River Inhabitants

about the same length. All these spans were replaced with heavier ones during the winter of 1915-16 by the Dominion Bridge Company, who built the old bridge in the year 1888. The new swing span is operated by a four-cylinder four-cycle marine engine, located in a cabin overhead in the centre of the span, which will open or close the bridge in one minute. The method of replacing these heavy spans, which



Bridge Over River Inhabitants

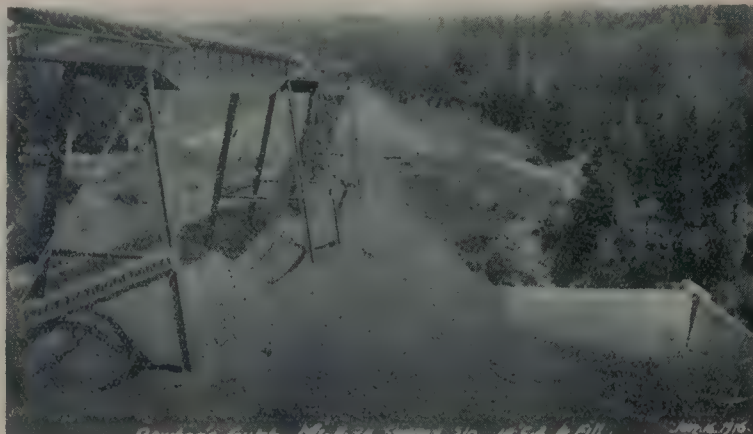
weigh about 400 tons each, was as follows: Falsework was driven at a point near the shore at the east end of the bridge, and each span was erected and rivetted up complete on this falsework. When a new span was ready to go in, scows containing water ballast were floated under the span to be replaced. Sufficient water was pumped out of the scows to allow the same to raise the span from its seat. Tugs then towed the scows and span away to the erection site, where it was deposited on the falsework by pumping water into the scows. The new span was then floated into

up with concrete. The part of the bridge seats immediately under the pier members consisted of concrete blocks, which were cast in the engine house at Point Tupper during the previous winter and were afterwards taken to the bridges and swung into place with a crane. Thirty two of these blocks were cast altogether, each weighing about two tons. The masonry alterations were made by our B. & B. men and the new steel bridges furnished and erected by the Canadian and Hamilton Bridge Companies.

Ottawa Brook and Walker's Gulch steel viaducts



McDonald's Gulch Viaduct, Showing Construction of Rail Concrete Culvert Before Filling Commenced—on right, two views of Dowling's Gulch Steel Viaduct, Showing Culvert and Filling



its place on the old piers in the same manner. The work of floating the spans could only be done under favorable conditions of wind and tide, which are somewhat rare at this place, and it took from the early part of November to the end of March to replace the seven spans.

In connection with the new steel bridges put in at Sydney River, River Deny's, River Inhabitants, Jamesville Road, Leitch's Creek and Ball's Creek, considerable alterations were necessary to the old masonry abutments and piers on account of the different design of the new bridges. The old bridges, with the exception of Jamesville Road, were of the through-pin connected-truss design, and the new bridges consisted of standard through or deck plate girder spans. The masonry alterations consisted of cutting down the old bridge seats to about a foot and a half below the elevation of the new bridge seat, or to the nearest masonry course, and building this

were entirely replaced with new steel of a heavier design and new concrete pedestals and abutments were put in. Ottawa Brook viaduct is 540 feet long, and consists of six 60-foot D. P. Girder spans supported on steel towers. Both viaducts are situated on curves. The concrete substructures were put in by Messrs. Jones & Girouard, Contractors, of Ottawa; the steelwork was furnished and erected by the Dominion Bridge Company.

The steel viaducts at Jamesville, Millbrook, Dowling's Gulch and McDonald's Gulch are being filled in. Most of this work, which was let by contract, has now been completed and the remainder will be done by railway forces next season.

To take care of the brooks under these viaducts, concrete culverts were constructed before the filling commenced. The culverts and all the work in connection with the filling of the viaducts were let by contract to Messrs. Jones & Girouard, who made the

fills from borrow pits along the railway right-of-way, using their own dump cars and steam shovels. To avoid damaging the steel towers of the viaducts by boulders striking them, aprons were constructed along the end of the ties for the full length of each viaduct, to throw the filling clear of the steel-work. Considerable trouble was experienced with the fill at McDonald's Gulch, great slides taking place on either side of the trestle. The fill slid out beyond the ends of the culvert, breaking one wing wall off and filling up the



Ottawa Brook Steel Viaduct, Showing New Steel-work in Place and Old Partly Taken Down

waterway. After the filling is completed to up around the girders, the girders are then removed, but the steel posts and the bracing of the towers remain in.

The fill at Dowling's Gulch has been completed and the girders taken out. This steel viaduct consisted of seven 30-foot spans and two 60-foot ones. The work of taking out the girders was accomplished in two days without any interference to express trains. Work was started on a Sunday morning, after express train No. 7 had gone down, and by six o'clock that night five of the nine spans had been removed, the grade made and the track laid and connected up. Between 7 a.m. and 5 p.m. the following day the remaining four spans were taken out, and the track laid and connected up in time to let express train No. 5 over. Acting B. & B. Master N. H. Langley handled the work of taking out the spans, and Roadmaster Wellwood built the track.

The photographs reproduced herewith will give an idea of the extent of the filling and other work mentioned above.

It was recently stated by Mr. Thomas Adams, town planing adviser to the Commission of Conservation, that Canada would have to build 30,000 houses annually for a number of years to meet the demand caused by the cessation of building operations during the war.

Methods of Thawing Mains and Services*

The methods used to thaw mains and services were many and varied, from the pick, shovel and teakettle to the "natural."

Hot water and steam were used in many cases, but they are manifestly not best suited for conditions which prevailed during the past winter.

The calls for help that went out from the water works fraternity to their brethren of the electrical fraternity resulted in the development of many types of electrical thawing apparatus.

The one best known and most generally used was through the overhead wires of the lighting companies. In this type the high-tension primary wires, carrying 2,200 to 2,400 volts, were tapped and the current carried to cut-out boxes with suitable fuse wires. From the fuse boxes the wire ran to one or more transformers whose capacities ranged from 15 kw. to 75 kw.

In the large majority of cases the voltage was reduced by the transformers to 110, and the amount of current delivered upon the pipe was further controlled by the use of a water rheostat.

The motor-generator set was used to a considerable extent.

One outfit consisted of a 25-volt, 250-ampere, direct current generator, equipped with a volt-meter, an ammeter and an automatic circuit breaker, mounted on a Ford truck. On the truck was also mounted a countershaft carrying a sprocket wheel at each end, and a driving pulley which was connected to the generator by means of a leather belt. On each side of the jackshaft of the truck was attached a new sprocket wheel just outside of the existing driving sprockets. Upon arrival at the point where the work was to be done, the chains were taken off the driving sprockets and attached to the new sprockets at the jackshaft and to those on the countershaft mounted on the truck. The Ford engine was thus utilized to generate the required current.

The storage battery was used to a limited extent.

One outfit consisted of three trays, each containing eight 2-volt cells, so connected up that a voltage of 16, 32, or 48 could be obtained. Another of six trays of four 2-volt cells each was still more flexible, as voltages of 8, 16, 24, 30, 36 and 42 were possible.

Another of six trays of three 2-volt cells was connected in multiple series, giving a voltage of 35. This outfit proved unsatisfactory, as serious damage was done to the pipes in a number of cases.

The properly connected storage battery has proved very efficient. Like the motor-generator set, it is flexible and portable, and, when operated by an experienced man, it is a safe method. If improperly used, damage to the pipes and to the battery itself can easily result.

The batteries must be recharged after a continuous day's use, the operation taking eight hours' time.

The storage battery is delicately constructed, and can be easily damaged, both in discharging and in recharging. It deteriorates when not in use, especially during the long period of the year when it is not needed.

To reduce the probability of damage to a minimum, an experienced man should be in charge of the work, instruments to determine both voltage and amperage should be used, reasonable time should be taken for the actual work of thawing, and under no conditions

*From the report of a Committee of the New England Waterworks Ass'n

should a larger current be used than experience has shown to be reasonable under similar conditions.

While available data are to some extent conflicting, and more exact information is desirable, yet general experience shows that, for the work of thawing $\frac{5}{8}$ -in. lead or $\frac{3}{4}$ -in. iron service pipes of average length, using 4/0 wire for leads, and with good connections, the following data may be considered as approximately normal:

Drop in pipe	14 to 18 volts
Total voltage required	20 to 30 volts
Amperes required	175 to 225
Time required to thaw	6 minutes, plus or minus

With larger pipes, or with pipes longer than the average, of course more electrical energy and time are required.

For all-round, efficient, economical work, the committee looks most favorably upon the motor-generator set. It is flexible, can go where the work is to be done, can work continuously, does not deteriorate when not in use, can be made almost fool-proof, and, if properly designed, is the safest type of apparatus from the point of view of danger to the water pipes.

New Warehouse at Saskatoon for the T. Eaton Co. Limited

A NEW fireproof warehouse has recently been completed at Saskatoon, Sask., for the T. Eaton Co., Limited. This is the first unit of a structure which, when completed, will be one of the largest of its kind in the West. The completed section measures 65 ft. x 135 ft., and is six storeys in height, the ceiling heights being fourteen and fifteen feet.

The building is of reinforced concrete construc-



Warehouse Under Construction for the T. Eaton Co., Limited, at Saskatoon

tion with twelve-inch brick curtain walls. It contains two flights of concrete stairs and two large freight elevators, the latter being enclosed with six-inch concrete partitions from basement to roof.

The mushroom system of concrete reinforcement was used throughout this work. The first and second floors are designed to carry a live load of 250 lbs. per sq. ft. and the remaining floors, a live load of 150 lbs. per sq. ft. Corrugated metal decking forms were used

throughout. Steel forms were used for the interior columns and wood forms for the exterior columns which were rectangular in shape. All columns were designed with caps and depressed heads.

Considering the most unfavorable labor conditions, remarkable progress was made upon this work. Excavation commenced in the middle of May of last year, and in the first part of October the owners moved into the building. For about one month during this time the work was tied up on account of a masons' strike. Most of the excavation was through a very tough clay which required the constant use of picks. The concrete work progressed at the rate of one floor per week.

The general run of the gravel about Saskatoon is not such as would warrant its use in concrete with good results. Serious defects have shown up in many of Saskatoon's concrete structures through this cause. In view of this, extra care was taken by the contractors in the selection of the aggregate for this work. It was found possible to obtain a good gravel at a little more expense than the ordinary run. Crushed stone, made from boulders collected about the country, was added to the bank run gravel in about equal parts. As a further precaution the forms for the concrete were left in place longer than would be the case under ordinary circumstances. No removing of shores or stripping of slab forms was done until the concrete was three weeks old. This necessitated the use of four sets of slab forms and two sets of column forms.

The layout of the construction plant proved very satisfactory. All of the hoisting towers were built outside the building. This layout allowed the elevator work and concrete stairs and other trades to proceed without delay.

The architects for this work were Woodman & Cubbage, and the general contractors, Hazleton & Walin, both of Winnipeg, Man.

Firms connected with the Canadian building industries will be strongly represented at the International Fair, to be held at Lyons, France, in March next. They include, Canada Foundries & Forgings, Limited, Welland, Ont.; Steel Co. of Canada, Montreal; Brandram Henderson, Limited, Montreal; Bishopp Wall Board Co., Ottawa; Metallic Roofing Co. of Canada, Toronto; Beatty Bros. Limited, Fergus, Ont.; London Concrete Machinery Co., London, Ont.; Pedlar People, Limited, Oshawa, Ont.; Asbestos Manufacturing Co., Montreal; Marsh Engineering Works, Limited, Belleville, Ont.; and Canadian Consolidated Rubber Co., Limited, Montreal.

Mr. V. I. Smart, formerly Professor of Railway Engineering and Transportation, McGill University, and Mr. J. A. Burnett, formerly electrical engineer, Grand Trunk Railway System, have opened an office at 821 New Birks Building, Montreal, as consulting engineers, specializing in civil, electrical and mechanical engineering.

At the recent annual meeting of the Toronto Branch of the Engineering Institute of Canada, the following officers were elected: Chairman, A. H. Harkness; secretary-treasurer, W. S. Harvey; executive committee, H. G. Acres, Willis Chipman, W. A. Bucke, Prof. Gillespie, J. R. W. Ambrose, Prof. Haultain and R. C. Wynne-Roberts.

Methods of Garbage and Rubbish Collection and Disposal in Larger Cities

AN investigation of the methods employed by various American cities for collecting and disposing of garbage and rubbish has been made recently by a committee appointed by the Mayor of Pittsburgh. This committee consisted of John A. Sauer, Superintendent of Bureau of Sanitation; F. F. Booth of the Division of Investigation, and of J. C. Slippery, Chief Accountant, Bureau of Costs. An abstract of their report, given in Engineering and Contracting, follows:

Baltimore.—The city of Baltimore collects its own garbage, ashes and rubbish, and pays a private contractor for reducing the garbage. In the early part of 1918, Mr. Walter E. Lee, Water Engineer of Baltimore, was directed by the Board of Estimates to visit different cities and make recommendations for improvements in the service. The outstanding features of Mr. Lee's report were that rubbish should be disposed of by incineration, incinerators being established in several sections of the city, and that the city dispose of its garbage by contract, for reduction. The highest bid received was \$23,000 per year, and the city decided to build its own reduction plant, entering into a contract with the Cobwell Corporation of New York. The Capital Issues Committee at Washington then intervened in the matter, and, on the ground that the adoption of either of the above plans would leave the present contractor's plant idle, requested the city to defer the construction of its plant for the period of the war, and continue the old contract (paying \$75,000 per year for reduction).

The cost of collection of garbage is not kept separately, the collection of garbage, ashes and rubbish being performed by the Department of Street Cleaning at a total cost of approximately \$225,000 per year, the total cost for collection and disposal of all city refuse being about \$300,000 per year.

Men on collection wagons are paid \$3.25 per day for 8 hours, one being employed to each wagon. The city is divided into four districts with a stable in each and in charge of a superintendent, each district being subdivided into routes. The reduction company removes dead animals.

Chicago.—The collection of garbage in Chicago is performed by city force under the ward system, a ward superintendent in each ward being held responsible for conditions in his district. Thirty-five inspectors, one for each ward, look after garbage complaints. The garbage must be accessible to the collector and if not properly separated, the Health Department makes the householder remove it at his own expense. Two men are employed for each collection wagon and are paid \$3 per day of 8 hours; \$8 per day is paid for team hire, if driven by owner or his employee, the garbage wagon being furnished by the city.

Collections are not made from all hotels, as many of these sell their garbage to a private collector engaged in hog feeding. A private corporation pays the city \$28,000 per year for privilege of removing dead animals.

The average cost per ton for collection in 1917

was \$3.42, and for the first six months of 1918 this figure was \$3.50.

The reduction plant was acquired by the city through condemnation proceedings several years ago, and additional machinery has been added from time to time. For this reason, the plant is not as efficient as one constructed under a complete scheme and engineered to meet all the necessities with a view to minimizing production costs.

In 1917, 4,023,480 lbs. of grease and 22,680 tons of tankage were produced, the average price received for these products being \$.0757 per pound for grease and \$10.27 per ton for tankage, due to sale as a whole under annual contract. Prices for the five months beginning Aug. 1, 1918, will be \$.1157 per pound for grease, and \$16.85 per ton for tankage. The production of grease for 1918 has fallen 20 per cent. under that for 1917. It was stated by the engineer in charge that in spite of this decrease the reduction plant would show a profit of \$47,000 for the first six months of 1918 on reduction without municipal overhead or interest on investment charge or plant depreciation.

Analysis made in 1918 shows that a ton of raw garbage contains the following:

- 2.00 per cent. grease.
- 22.65 per cent. tankage.
- 75.35 per cent. moisture and rubbish.

Tests show that the grease produced in the plant contains 8 per cent. glycerine.

A very complete cost-keeping system is used by the Bureau of Streets, and the costs given are accurate, but do not include interest and depreciation on the plant investment. The preliminary system of handling raw garbage in this plant is not considered sound practice by others in the work as the garbage is first submitted to a hot air dryer, only the steel sheets on the revolving drums being between it and the flames, thus carbonizing a percentage of the grease and tankage into inert and practically valueless matter.

Cincinnati.—Garbage collection and disposal in Cincinnati is performed by a private contractor under a lump sum contract, this contract expiring Dec. 1, 1918.

Two men are employed on each collection wagon. The city pays \$3 per day for drivers and \$2.75 per day for helpers on ash collections, and the contractor probably pays the same rate for garbage collection.

The amount of garbage for 1917 estimated at 48,000 tons.

Dead animals must be removed by contractors on notice.

Cleveland.—The city of Cleveland collects its own garbage and operates its own reduction plant at Willow, O.

The district system of collection, similar to the ward system in Chicago, is used. The average length of haul to the loading station is now from 4 to 6 miles. The construction of four loading stations, now plan-

ned, will reduce the length of haul to 2 miles, and cut the cost of collection accordingly.

One man is employed on each collection wagon, being paid \$3.75 per day.

In 1917, 3,071,022 lbs. of grease and 6,241 tons of tankage were produced from the garbage. This is sold under an annual contract, the prices received being \$.135 per pound for grease and \$18.82 per ton for tankage.

In May, 1917, the garbage yielded 3.23 per cent. of grease. In May, 1918, this percentage had fallen to 2.57 per cent.

A few years ago the city of Cleveland had an appraisal made of all city property and this appraisal was written up in the auditor's books and kept under control currently, maintenance costs being charged as such and depreciation being written up yearly. The effect of this system is to place the accounts of the city, particularly those bureaus which are entirely or in part self-supporting, on the same basis as that of a private corporation.

The average cost for collection and disposal over the five-year period, 1913-1914, was \$1.76 per ton.

The Cleveland city plant differs from that of Chicago in that the raw garbage is immediately placed in high tanks called digesters, and cooked under steam pressure, thus eliminating the deterioration in quantity and quality of the subsequent products, although the balance of the operation is more complicated and cumbersome, and makes a slightly higher reduction cost based on the amount of raw garbage handled than does the system in use in Chicago.

Kansas City, Mo.—Kansas City pays \$57,000 per year to a private contractor for removal and disposal of garbage, 53,000 tons alleged to have been collected last year. The contractor feeds the raw garbage to hogs on a ranch located near the Kansas City Stock Yards. This contractor, C. Rhea, also operates hog feeding ranches at Nashville, Tenn., and Camp McClellan (Anniston, Ala.).

The Kansas City contract is for three years and calls for at least two collections per week from residences, and one per day from hotels, hotels and restaurants being permitted to sell their garbage to the contractor. No other person is allowed to collect garbage, although the contractor can sublet districts to other collectors. A bond of \$25,000 is furnished to the city by the contractor.

The drivers of the collection wagons are paid \$2.75 per day, only one man being employed on each wagon.

Sixteen inspectors attached to the Department of Health look after garbage complaints, but city officials stated that they were getting good service.

At the Kansas City ranch, garbage is fed on concrete slabs, these being washed each morning. No more odor is evident in this ranch than that common to the ordinary stockyard. The hogs used are first inoculated against hog cholera, the contractor averring that, in this operation he lost 5 per cent of the number treated. St. Louis, as a municipality, tried this experiment of hog feeding with garbage for a short time, but it was not wholly successful. Reduction plant pays 3 ct. per pound for dead animals.

Milwaukee.—The municipality owns and operates an incinerator and collects garbage, ashes and rubbish. Teams were secured for \$4.50 per day in 1917, but the 1918 rate has increased to \$6 per day. Collections are not made from hotels, these selling to private collect-

ors who use it for hog feeding. It was stated that the ordinary household garbage carried an extremely small percentage of grease. Twenty-six inspectors look after complaints. In 1917, 46,979 tons of mixed refuse were burned at the incinerator at a total cost of \$72,079, or \$1.53 per ton. This per ton cost is applied to the total tons of garbage collected in arriving at the cost of incineration given. Steam is generated at the incinerator and furnished to the Milwaukee River flushing station.

Milwaukee requires the householder to paper wrap all garbage and place where immediately accessible for collection. The garbage wagons bearing these paper wrapped parcels were not noticable for odor from the sidewalk, and that factor was only discernible on closely approaching the vehicle. From the standpoint of unobjectionable service this condition was only equalled in other cities where the garbage was similarly handled. Unfortunately, the system is fatal from a reduction standpoint, the paper absorbing so much of the grease, and there is no method for removing it, and, in addition, the labor entailed in unwrapping makes it out of the question. Dead animals are removed by city force.

Minneapolis.—Up to 1918, the city of Minneapolis disposed of its garbage by incineration, conducting both operations, collection and incineration, with the city force. In the early part of this year, the city let a contract to the Reservoir Heights Pig Feeding Co. to take all the garbage delivered by the city f.o.b. cars at the central loading station, and pay the city \$1.26 per ton delivered, the city using the paper wrapped method of collection. For collection purposes, the city is divided into 34 districts, a collector in each district being held responsible for the work in his district. Two men are employed on each wagon, the collector being paid \$130 per month for his service with the team, and the helper, \$2.80 per day for 8 hours, the city owning the wagons. The collectors haul their loads to three sub-stations, and from these points, the garbage is taken by wagon and trailer to the loading station. Collections are only made from residences, the hotels selling their garbage to private collectors.

The Minneapolis garbage is handled in a similar manner to that of Milwaukee, the householder being required to drain and wrap it in paper before it is placed in the cans. No tin cans, crockery or glass are allowed in the cans, the Health Department looking after proper separation.

An analysis of the garbage made in 1917 in all city wards showed that it contained only 1 per cent. of grease. Dead animals are owner's property and sold by them.

New York.—The collection of garbage in the three boroughs of Manhattan, Brooklyn and the Bronx in the city of New York is under the jurisdiction of the Department of Street Cleaning.

The contract for disposal of garbage was with the Metropolitan By-Products Co., the contractor to pay the city the first year \$120,000, with an increase of \$30,000 per year for the remaining four years. This contract began operation on January 2nd, 1917, to continue for a period of five years. The new Staten Island plant, using the Cobwell system, started operations in April, 1917, and, in December, was receiving all the garbage from Manhattan, The Bronx and Brooklyn.

Philadelphia.—The collection and disposal of gar-

bage in Philadelphia is performed under lump sum annual contract, the amounts for the last few years being as follows: 1917, \$432,000; 1918, \$575,256; 1919, \$486,000.

No check is kept on the amount of garbage collected, except that the total amount collected during some month is weighed and thus used as the average. Inspectors keep a close watch on complaints, being required to turn in a report on the complaint 48 hours after its receipt. The contractor is fined \$1 per day for each house which he fails to collect from.

St. Louis.—Garbage is collected in St. Louis by city force and delivered to a contractor at dumps on barges and is then transported to the reduction plant at their expense. The city pays \$.87 per ton to the contractor for disposal and the contractor stated that he was willing to renew at that figure, but would not accept less or pay any bonus for it.

The district system, similar to that of Chicago, is used in collection. One man is employed on each wagon, he being paid \$75 per month for 8 hours per day. The average length of haul to the dumps is, at present, $4\frac{1}{2}$ miles, but the engineer stated that, by the construction of loading stations, this could be cut to $2\frac{1}{4}$ miles. Four inspectors attached to the Department of Streets and Sewers, look after complaints.

St. Paul.—About half of the garbage in the city of St. Paul is collected by the city, and the balance by 54 licensed collectors who pay a license fee of \$5 each per year. Garbage collected by the city is delivered to hog farms just outside the city limits, selling at an average price of from \$1 to \$1.25 per ton.

Teamsters on city collection are paid \$100 a month, and furnish the teams and running gear, and the city, the wagon boxes. City wagons are provided with an opening for draining each load, before being delivered to the contractor.

The length of haul is much higher in St. Paul than the average city, as the garbage is hauled two miles further out of the collection districts than would be required if some other system of disposal were adopted.

There is no regular collection of refuse and ashes, the householder being required to dispose of these by having them hauled away by the licensed scavengers at his expense.

U. S. Steel Merger for Export Trade

A big steel merger for export trade has recently been effected in the United States. The North American Steel products Corporation has been organized, representing the following companies, with a combined annual ingot capacity of 12,000,000 tons: Bethlehem Steel, Brier Hill Steel, Lackawanna Steel, Lukens Steel, Medvale Steel and Ordinance, Republic Iron and Steel, Sharon Steel Hoop, Trumbull Steel, Whitaker-Glessner and Youngstown Sheet and Tube Companies. E. A. S. Clarke, president of the Lackawanna Steel Co., will be president of the new corporation, his resignation from his present position taking effect Jan. 1. It is expected that other producing interests will join the North American company later, and that eventually it will represent in export trade substantially all steel-producing companies of the country with the exception of the United States Steel Corporation. In addition to its proposed principal office in New York City, it will have branches throughout the world, wherever the introduction and sale of American iron and steel products make it desirable.

Imperial Oil Co. Improving Workmen's Conditions

The Imperial Oil Co., Limited, is taking steps to promote friendly relations between the firm and the employees and to advance their mutual welfare by the inauguration of the so-called trade parliaments, such as have been established in Great Britain. Briefly, the plan is this: The employees will elect by free and secret ballot workingmen's committees representing the many trades that enter into the oil industry in numerical proportion, one delegate for every 75 employees being the scale adopted, and these delegates will sit jointly with an equal number of officials appointed by the company to deal with all grievances, questions of wage increases and plans for the betterment of social conditions of the worker.

The initiation of this scheme was announced at Sarnia on Dec. 18, at a banquet held in the council room of the board of trade, which was attended by the chief officials of the company and the delegates of the employees, Hon. W. J. Hanna, president of the company, presiding. The plan is to take effect in all the plants of the Imperial Oil Co. throughout Canada, including refineries in Halifax, Montreal, Regina, Vancouver and Sarnia.

Table 1.—Garbage Collection and Disposal in American Cities—1917

City	Population	Area, sq. mile	Population per sq. mile	Amount collected.		Cost of collection.		Net cost of disposal.		Net cost of collection and disposal.	
				Tons	Lb per capita	Per ton	Per capita	Per ton	Per capita	Per ton	Per capita
Baltimore . . .	589,621	32	18,425	62,300	211	....	....	\$1.20	\$0.12	....	\$0.508††
Chicago. . .	2,497,722	198	12,615	100,146	80	3.42	\$0.13	.31	.012	\$3.73	.14
Cincinnati . . .	410,476	72	5,701	48,000*	233	....	....	....	....	1.54	.18
Cleveland. . .	674,073	53	12,718	56,121	166	4.20	.34	1.80*	.14*†	2.39	.20
Kansas City ..	300,215	61	4,921	45,000*	299	....	....	....	....	1.26	.18
Milwaukee . . .	436,535	36	12,125	30,975	141	4.18	.29	1.53	.10	5.71	.39
Minneapolis . .	363,454	54	6,730	20,834	114	3.87	.22	.95	.05	4.83	.27
Philadelphia . .	1,709,518	130	13,150	125,000*	146	....	....	....	....	3.45	.25
Pittsburgh . . .	579,090	41	14,124	83,013	286	....	....	....	....	2.25	.32
St. Louis . . .	760,454	61	12,466	45,136	118	2.90	.17	.87	.05	3.77	.22
St. Paul . . .	247,232	55	4,495	14,628†	118	6.08	.17	....	....	5.03	.14
Washington . .	366,631	70	5,237	44,683	243	....	....	....	....	1.56	.19
New York ¹ . . .	5,138,352	..	....	403,665	157	....	....	....	....	....	....

¹Boroughs of Manhattan, Bronx and Brooklyn. *Estimated. †Total, of which 7,215 tons is collected by city. *†Revenue. ††For garbage, rubbish and ashes.

Instructions for the Operations of State Sewage Plants

THE Texas State Board of Health recently issued a Bulletin of Instructions for the operation of state sewage plants. The Bulletin was prepared by the Bureau of Sanitary Engineers and contains the following useful information:

Septic Tanks.—Great depths of scum should not be allowed to form on the surface of the liquid. This should be frequently broken, liberating the entrained gases and allowing the solids to settle where more active decomposition will take place. A stream of water under good pressure can be used to good advantage for this purpose.

Remove sludge from bottom of septic tank at least once in every three or four months.

This sludge should be spread on drying beds in order to facilitate the dewatering of same, after which it can be either burned or carted away.

Grit and Screen Chambers.—Do not allow deep accumulations of grit to remain in the grit chamber. This grit should not be allowed to wash into the settling chambers, but should be disposed of outside of the tanks. Clean screens once every day. Record date of cleaning, amount of screenings, how disposed. Bury or burn screenings as soon as removed. Flush bottom of screen chamber as needed. There will probably be some heavy matter which will not be caught on the screen, but which may lodge back of the screen, and this should be flushed out before it has started to decompose. Specified intervals cannot be given for this flushing, but a careful watch kept for these conditions will enable the operator to know when to flush.

Imhoff Tanks

Channels.—Keep channels clean at all times. Flush out deposits once a day in winter and twice a day in summer. Clean channels thoroughly before reversing flow in tanks. Deposits are most likely to occur in channels at the inlets to the tanks. Care must be taken that these deposits are washed into the tanks and are not allowed to get into the outlet channels. Before reversing the flow through the tanks, be sure that the channel which is to become the outlet channel when flow is reversed, is thoroughly cleaned and that the deposits are swept into the tanks. Deposits in channels tend to cause odors.

Settling Compartments.—Skim off oil, grease and all floating matters at least once every day. Dispose of oil and grease outside of tanks. Do not let oil from barrels get into catch basins. Floating materials, such as matches, corks, rubber goods, etc., behind baffles and all scum collecting upon the surface of the sewage passing through the chambers should be removed. This can be done by means of a dish-shaped perforated skimmer, perhaps 18 to 20 inches in diameter, attached to a long wooden handle. The scum and floating material may be thrown into the scum chambers. Clean sides and bottoms of settling compartments once a day in winter and twice a day in summer. This may be done with a rubber squeegee, a flat hardwood board from 12 to 24 inches long and from 3 to 4 inches wide with rubber edges and a light wooden handle of length determined by the diameter of the chambers. Clean

slots once a day. Reverse flow in tanks every two weeks. Remove all floating matter between scum boards and end of tanks before reversing flow. In cleaning down the sides of the settling chambers the cleaner should be moved slowly and the deposits removed from the sides forced through the slot into the sludge chambers. This is especially necessary at the outlet end of the tanks so that the matters scraped from the walls are not stirred up and carried away into the outlet channels. See that every part of the tank is cleaned, for if deposits adhere to the sides and decompose odors are sure to result. At times of reversing flow, clean down thoroughly all parts of the tanks between the scum boards and the end of the tank at the inlet end (or what will be the outlet end when the flow is reversed). After the deposits which have been stirred up in cleaning have been settled, reverse the flow. Most of the floating matter on these tanks can be made to settle by sprinkling with water. Oil and grease, however, must be skimmed off and removed from the tank.

Sludge Chamber.—Measure and record depth of sludge once a week. This may be done by means of a weighted board or sheet iron plate from 12 to 18 in. square attached to a wire or cord or to a long light rod of wood or gas pipe. Stir up sludge once a week with pressure water through perforated lead pipe. Excessive scum formation can sometimes be checked by the occasional use of this perforated pipe. When this is done some of the gas in the sludge is driven off and there is consequently less tendency for it to rise into the scum chambers. Furthermore, if the activity of the organisms in the sludge seems to be retarded, due to the excessive formation of so-called enzymes or other by-products of their existence, these may be disseminated and diluted by spraying water through the perforated pipes in question. Never let sludge get to such a depth that its upper surface is nearer than 18 inches to the slot. Measure and record depth of sludge about two hours before and after removing sludge. Remove sludge about every two months. Flush sludge pipes with pressure water after removing sludge. About an hour before removing sludge, open valve for a few minutes so as to loosen up the sludge about the sludge riser pipe. This should be done some time before the sludge is drawn, so that the sludge has time to settle; otherwise partly digested sludge may be withdrawn to an objectionable extent. To remove the sludge, open the valve at the sludge riser; the pressure of the water above will then force sludge into the pipes leading to the sludge bed. If from any cause the sludge pipe should become clogged it may be cleaned by pushing a rod through it or forcing water or clarified sewage through it under sufficient pressure. Sludge should be removed from one pocket of the tank at a time. It is better to remove smaller amounts of sludge at frequent intervals than to withdraw large quantities infrequently. After withdrawing sludge, the sludge pipes must be flushed. This can be done by opening the valves or by back-flushing from water connections. The water used in flushing should be discharged upon a section of the drying beds

on which there is no sludge. The line leading to the beds may be back-flushed, if necessary, by putting water from a hose in the pipes at the beds. Water must be kept at the sludge drying beds. If partly digested sludge appears, the valve leading to the bed must be closed at once. Partly digested sludge can be recognized by its grayish color, and by its foul odor. Digested sludge is brownish-black, with only a faint tarry or rubbery odor, which disappears in a short time, having the sludge with an odor similar to garden soil.

Gas Vents or Scum Chambers.—Break up scum in gas vents daily. Record distance from top of scum to top of walls. Record appearance and odor of scum. If the floating scum or sludge which collects in the gas vents cannot be broken up by sprinkling with water, then it will have to be broken up with a pole, spade or otherwise. Large quantities of scum must not be allowed to collect in the gas vents. All matter which will not settle by sprinkling or agitation, should be removed from the tank and burned. Great depths of scum will not digest properly and may give off more or less offensive odors of decomposition. No decomposing material should be allowed to accumulate in these chambers, otherwise septic action may take place and disagreeable odors be produced.

Sludge Drying Beds

Put sand on beds before putting on sludge. Put sludge on beds preferably to a depth of about 6 to 8 inches; never over 12 inches. Make the necessary measurements and records called for by the operating sheets. Before applying sludge to the drying beds, a thin layer (about $\frac{1}{8}$ in.) of sand or very fine stone should be put on the beds. This will prevent the sludge from working down into the stone on the beds. Never put partly digested sludge on the drying beds, but bury at once. Do not put freshly withdrawn sludge on top of sludge already on the beds, as it will not dry quickly. Do not remove from the drying beds sludge which is only partly dried. Wet or freezing weather interferes with the drying of sludge, so that it is better not to withdraw sludge during wet or freezing weather. After drying, sludge may be used as a fertilizer upon lands, or it may be used for filling in low places. It is well worth hauling away and utilizing upon cultivated lands. It has the advantage of being able to lighten heavy soils and would no doubt furnish humus to soils which are lacking in this feature. When deposited in fills, the thoroughly digested sludge does not undergo putrefaction and will not cause any nuisance due to odors. Measurements should be made as soon as the sludge is placed on the beds and just before removal from the beds. Weather conditions should be carefully recorded.

Dosing Chamber

All floating matter which may have passed through the settling chambers into the dosing chambers must be skimmed off. These matters if allowed to discharge will clog the nozzles of the filters. Clean down sides of tank and do not allow accumulations to adhere thereto. Clean bottom of tank whenever any appreciable amount of matter remains in same after discharging. See that all pipe connections to the siphon are perfectly tight. If joints are not air tight, the siphon will not discharge properly, if at all. If screens are placed in dosing chamber, clean same daily.

Sand Filters

Except in emergency cases no sand filter shall be used continuously for more than one day, but should

be dosed alternately, arranging so that one bed can be cleaned and rested without interfering with the successful operation of the plant. Every morning before dosing beds they should be raked lightly to a depth of $\frac{1}{2}$ inch with fine sharp rakes. When the surface of the filter sand becomes so clogged that the sewage does not percolate into the filter, allow bed to rest until the surface is dry and then rake the sand to a depth of $\frac{1}{2}$ inch or slightly deeper. When this will no longer increase the porosity of the surface sufficiently to permit the sewage to percolate, put the filter out of use and after resting and drying, scrape off and remove the clogged surface of sand to a depth of approximately $\frac{1}{2}$ inch; then loosen the surface lightly with sharp pointed rakes; then allow bed to rest at least one day before again putting into service.

Contact Beds

The surface of the stone should be kept at a point 3 or 4 inches above the water level in the beds. This will prevent the attack of flies on the sewage. The automatic control apparatus must be kept in perfect operation at all times. After a service of five years, more or less, the contact material becomes filled with solids and will have to be removed, cleaned and replaced.

Sprinkling or Trickling Filters

The nozzles should be examined every day and thoroughly cleaned. The side walls should be carefully washed down, and kept free of dirt, flies and gnats. The main drains should be flushed out at least once a week with water under pressure. If dirt and dust settles on top of filter same should be removed and the bed washed with water so as to prevent clogging. Keep the bed free from leaves, paper, etc. If the mat which forms on top of the floor becomes so thick as to prevent the percolation through the filter, it should be raked off and the bed carefully washed with water.

Activated Sludge Method

The purification of sewage by aeration in the presence of activated sludge is still in its infancy, and the varied character of plants being built forbids the giving of full instructions covering all of the details of operation. Each plant will have to be governed by special instructions of the engineer in charge, but a few general directions may be given as follows: All dust and oil should be excluded from the air introduced. The presence of grit seriously affects the process, hence attention should be given to the grit chambers to see that they are functioning properly. All sewage should be first screened before entering aeration chambers in order to remove all indestructible matter such as rags, orange peelings, matches, corks, rubber goods, etc. A close observation must be kept on the operation of the diffusers (filter plates, wooden diffusers, or perforated pipes) in order that the maximum efficiency may be derived. Air should be delivered in large quantities of very small bubbles distributed through the entire cross section of the tank, rather than large bubbles in portions of the tank. Broken diffusers, or diffusers which have become worn or clogged will not operate properly. Provision must be made for the de-watering of the sludge. This may be done by providing large sand areas upon which it may be dried or by providing suitable presses for the purpose. In drying the sludge upon sand beds a larger area is required than for Imhoff tanks sludge and it should be placed upon the beds in thin layers as it dries very slowly. One method which seems to be especially favorable to Texas conditions is the mixing of lignite dust with the

sludge as it is withdrawn from the tanks, subsequently placing the mixture upon the sand beds to dry. This mixture dries much more rapidly than the unadulterated sludge and after drying may be used as a fuel, thus disposing of the sludge as well as utilizing the dust.

Chlorination

The amount of chlorine to be used shall be determined by actual tests and there shall be left posted in the chlorination house a chart giving the amount of dose required for various flows of sewage effluent, and shall also state in detail the method of operating the chlorinating apparatus. The operator shall not make any change or adjustments in the equipment other than regulating the flow or dose without first receiving permission from the superintendent in charge.

Measurement of Sewage

The flow of sewage into the tanks should be measured from time to time in order to obtain the volume of sewage entering the tank. Where daily tests are made on the effluent it will be necessary to know the amount of sewage being treated to arrive at an intelligent conclusion as to the purification perfected.

Stamping and Testing

Make tests of the amount of the settling solids in the raw sewage and the tank effluent every day at 2 p.m. by the use of conical glasses. Make putrescibility tests every day of samples of the raw sewage, tank effluent and final effluent. These results of putrescibility tests with methylene blue should be recorded on a percentage scale in terms of stability as recommended by Professor Phelps of the United States Public Health Service and listed on page 38 of Fuller's book on "Sewage Disposal." Make bacterial tests every day at 2 p.m. corresponding to sample in the schedule above stated for putrescibility tests.

Records of Operation

Keep full records of results of operation at the plant, posting the results with a pencil in white line prints of the record form. These pencil records should be signed by the attendant and sent to the State Board of Health after the Sanitary Commission has looked them over carefully with the attendants. On operating sheets should be kept a complete record of all data touching on the operating features above stated. In addition there should be a complete record of the height of water in the stream into which the effluent is discharged, and in the operation of troubles, such as odors, unsightly conditions in and around the plant, all of which unusual features should be put onto the records under "Remarks." The attendant should keep a diary at the plant to record any unusual features that do not appear on the pencil notes on the operating sheets. The diary should record the receipt, or the ordering, or the need of any new supplies, or changes at the plant. The diary should show the presence of any number of extra workmen employed and what they do. It should show visits from any of the machinery concerns and the cause of their visit. It should deal with the special things and the operating records should deal with these things which are of regular occurrence. The diary, together with the operating records, should give a complete history of the plant from day to day and the attendants should be taught not to be afraid to put down things which seem adverse or unfavorable to them, because the record of such observations is the surest way of leading to a prompt and satisfactory remedy of unsatisfactory items and the improvement in operating conditions as the flow of sewage and other factors change from time to time.

Mainly Constructional

East and West—From Coast to Coast

The Foundation Company will establish a steel shipyard on the Pacific Coast. It is possible Vancouver may be selected as the site.

The Eadie-McNeilly Construction Co., Ltd., has been incorporated with a capital of \$50,000, head office at Ste. Agathe des Monts.

The Ontario Government has purchased the toll road between Cobourg and Port Hope at a cost of \$8,000, and will incorporate it in the new provincial highway system.

The Foundation Shipbuilding Co. has placed with the Vulcan Iron Works, Vancouver, a \$1,000,000 order for boilers to be used in the ships it is building at Victoria for the French Government.

Siems, Carey, Kerbaugh, Limited, whose head office is in Winnipeg, Man., has registered as an extra-provincial company in British Columbia, being authorized to carry on a general engineering, contracting and construction business.

The town of Oshawa, Ont., has petitioned the Dominion Government regarding the provision of a harbor there. In 1913 there was an item of \$100,000 appropriated for that purpose, but with the coming of the war it was struck off.

A public utilities commission has been formed in Galt, Ont., composed of four commissioners, combining the administration of the waterworks and hydro-electric departments under the one body.

Mr. J. W. Evans, of Revelstoke, B. C., has bonded the Mountain Chief Mine, at Renate, which is a gold, silver and ore producer, for \$100,000, and plans to start on development work immediately, putting in a tramway from the mine to the Arrow Lake.

The building permits issued in London, Ont., during 1918 number 774, and are valued at \$876,000, as compared with 843, at a value of \$837,890 for 1917. December's issue was 19 permits, valued at \$27,980, as against 26, at a value of \$34,590 in the same month in 1917.

It is interesting and encouraging to note that there are six building men on the Toronto City Council for the year 1919—Messrs. Hiltz, Birdsall, Sykes, MacGregor, Maher, Williamson. The prospects for a vigorous campaign of reconstruction are therefore bright.

The Engineering Corporation, Limited, has been incorporated with a capital of \$25,000, head office at Vancouver, B. C., and is authorized to carry on business as consulting and general engineers, general contractors and sub-contractors, and agents for all kinds of public, private and other works, projects or businesses.

The T. Eaton Co. will erect in Toronto, at the corner of Hayter and Buchanan streets, a \$200,000 building for delivery purposes. This structure will be 43 ft. high and have 118,000 sq. ft. of floor space. It is for temporary use only, to relieve congestion, and will later be torn down to make room for the proposed \$11,000,000 store. Messrs. Sproatt & Rolph are the architects.

The Manitoba Government has decided to erect a home for the deaf and dumb, at a cost of approximately \$500,000. It will be located in Winnipeg or the vicinity. Accommodation will be provided for at least 300 pupils. There will be thirty class rooms provided, and the usual reception rooms, administration offices, play rooms, swimming pool, gymnasium and vocational training rooms. Other buildings will be a temporary hospital, principal's residence and central power

plant. Five leading architectural firms have been asked to submit plans, all of which are to be purchased by the government, and the best ideas in each adopted.

The Dufferin Construction Co., Ltd., has been incorporated with a capital of \$50,000, head office in Toronto, Room 505, Lumsden Building. Mr. J. Franceschini is the president and general manager, and Mr. Chas. Johnston is the vice-president. Mr. Johnston was connected with the engineering work of the Toronto-Hamilton highway. General construction, engineering and road work will be undertaken by the new firm.

The scheme which is proposed for the improvement of the Fraser River includes the construction of two jetties, one on the north side and one on the south side, to confine the channel across the Sandlands. The north jetty is partly built and it has now been decided to ask the Dominion Government to include in its estimates for public works next year an appropriation for the construction of the first unit of the south jetty.

The Minister of Public Works, in a recent interview, gave the representatives of the Toronto Harbor Commission assurance that there would be work undertaken on the harbor during 1919 sufficient to keep over 800 men busy. Particular reference was made to the concrete superstructure of the breakwater at the western extremity of the harbor and it was intimated that this would be proceeded with to protect the work already done.

A resolution was recently passed by the Toronto board of control requesting the commissioner of works and the assessment commissioner to prepare a plan of a subway under the G.T.R. and C.P.R. tracks on West Bloor street, between Dundas St. and Lansdowne Ave., and to estimate the land damages and the probable cost, with a view to having an application made to the railway commission for an order for grade separation in this locality and to prepare the way for a cross-town car line on Bloor street.

The Building Trades League has decided to take a referendum vote of the unions upon a shorter work day. The men will be asked to settle on an eight hour day, five days a week, with no work on Saturdays, or a seven-hour day five days a week, with a three-hour Saturday. The unions affiliated with the League propose to make this measure universal, the object being to reduce unemployment during the period of reconstruction.

There are three proposed routes for the western section of the Provincial Highway, regarding which Western Ontario delegations have been laying claims and counter-claims before the Provincial Government. The northern route, known as Longwood's Trail, is 116.12 miles in length and runs from London through Chatham to Windsor. The middle route, London, Charing Cross, Windsor, is 127.67 miles long. The southern route is 140.31 miles in length and runs, London, St. Thomas, Leamington, Windsor.

In a recent issue of the Canada Gazette notice is given of the incorporation of "Leaside Munitions Company, Limited," with a capital of \$10,000,000, and head office at Leaside, Ont. Among the objects for which the company is stated to have been formed are: "To carry on the business of mechanical, electrical, hydraulic, chemical and civil engineers and metallurgists, machinists, brass and iron founders, iron and steel converters, structural steel workers," etc., and "To contract for and to undertake the building, construction and erection of machinery, warehouses, buildings and structures and plants of every kind and description, and to carry on the business of contractors and builders."

The case of Thomas O'Sullivan versus the city of Montreal, in connection with the former's claim for \$84,000 on the La Salle Bridge contract, has been opened. The claimant

was awarded the contract for \$210,000 on October 21, 1916, but the city later undertook to transfer the contract to another firm. O'Sullivan claims that the flooding of the premises where the bridge was being built and the difficulty of obtaining iron and steel, due to war conditions, caused the delay which the city made the grounds for the cancellation of his contract, and he asks for the sum of \$84,000, alleging that this amount is owed him for work done and for breach of contract.

Obituary

Hon. Jas. McShane, formerly Minister of Public Works for the Province of Quebec, and also at a later date harbor master of Montreal, died recently at the age of 85 years.

Mr. John A. Croll, a prominent contractor in Huron county, Ont., died recently, at Clinton, at the age of 81 years. Mr. Croll was a native of Scotland, and came to Canada when a child.

Mr. Chas. E. Richardson, of Kerrisdale, B. C., has died of pneumonia following the influenza. Mr. Richardson, who was one of the oldest residents of the municipality of Point Grey, was a well known building contractor and was also a prominent figure in municipal life.

Mr. Joseph Bourque, of Hull, a well known contractor, died in that city, on December 23, after a brief illness, age 53. Mr. Bourque carried out a large number of contracts in Eastern Canada, notably the Church of the Sacred Heart, Ottawa, Notre Dame de Grace, Hull, the Court House, Hull, Montreal General Post Office, and the Ecole des Hautes Etudes, Montreal, and the Post Office and Custom House, Three Rivers.

In the death of Mr. Edmund Burke, senior partner in the firm of Burke, Horwood & White, Toronto has lost one of its best-known architects. The deceased, who was sixty-eight years old, died of pneumonia. He was born in Toronto, being the son of Mr. Wm. Burke, a well-known contractor of the city's early days. He received his education first at Jesse Ketchum School, and later at the old Upper Canada College on King Street. In the offices of Gundry & Langley, Toronto, he studied for his profession, becoming a partner of Mr. Langley in 1872. Afterwards he took over the business of the late W. G. Storm, R.C.A. Among the many important buildings in Toronto designed by Mr. Burke were the following: The Metropolitan Methodist Church, Sherbourne Street Methodist Church, Jarvis Street Baptist Church, Walmer Road Baptist Church, Trinity Methodist Church, Castle Memorial Chapel, McMaster University, the Robert Simpson store, the Toronto Conservatory of Music, Y.M.C.A. buildings, Meteorological building on Bloor Street, and the new Methodist Book Room. For some years Mr. Burke was a councillor of the Ontario Association of Architects and held the office of President of that body in 1894 and 1905-6-7. In 1910 he was vice-president of the Royal Architectural Institute of Canada.

New Book

Mensuration Made Easy, or The Decimal System for the Million, with its Application to the Daily Employments of the Artisan and Mechanic, by Charles Hoare; publishers, Effingham Wilson, London; price one shilling net. Owing to the imperfect system of education the most useful and, at the same time, the easiest course of teaching, namely decimal arithmetic, is omitted in youth. This book is written for the express use of the artisan and mechanic, who will find, with moderate practice, they can obtain with ease and accuracy results of calculations connected with their daily occupations, which would have been beyond them under the old fractional system.

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Lack of Consideration for Those Who Submit Tenders

IN the submission of tenders for municipal work, contractors are tied down to certain exact procedures and formalities by by-laws and specifications. Everything, down to the last formality, must be carried out according to the letter of the law. This is troublesome enough at times, but no doubt necessary for the mutual protection of the contractor and the public. So the contractor, on his part, follows the line of red tape without protest but, we believe, has a perfect right to expect that the municipal authorities should be just as strict in their own adherence to the regulations as they are in enforcing them upon others. However this apparently is not always the case, and in the city of Toronto there is evidence of increasing discontent among contractors in regard to the city's manner of handling tenders.

The city's by-laws demand that certain formalities be complied with in calling for tenders, and to anyone who is not familiar with the methods of the Toronto Board of Control in opening tenders, it would appear to be according to Hoyle in every respect. Attendance at a board meeting when business of this kind

is on the slate would, however, disillusion one to some considerable extent, to say the least. The envelopes containing tenders, accompanied by marked cheques, are slit open one by one, passed to His Worship the Mayor for perusal, and a few, very few, of those first opened, are read out in an almost inaudible voice. We are told there is no system of tabulating or registering tenders as they are received. Consequently, if this condition obtained in some other cities outside Toronto, there would probably be raised the old cry of graft, and certainly this system allows every opportunity for a certain amount of hokus pokus. We are further advised that tenders are left lying around, and there is little to prevent a belated tender being slipped in or a new tender being substituted for an old one. It is farthest from our intention to insinuate that these things are being done or that there is collusion of any sort, but we do say for the sake of the city of Toronto's good name, and in fairness to the contractors, this laxity in the handling of tenders should not be permitted.

Notwithstanding the evident irregularities of this state of affairs, the contractors and material supply men themselves are not registering any strenuous kick at these conditions, which speaks highly for the city's reputation. What they are worried about is their inability to secure any information as to how they stand on the work they have figured on. Contractors and material men from all over Canada, and material firms from Chicago, New York and even from as far south as Texas, and east and west from coast to coast, are tendering on Toronto municipal work. They have representatives here when the tenders are opened, but after spending several days in an endeavor to find out how they stand they are forced to give up the attempt in disgust.

It should be a simple matter to tabulate and post up the tenders received as soon as they are opened. This would relieve those who are hopelessly high from the necessity of holding material necessary for the job when there is no possibility of their securing the contract and thus release this material for other work. It would also save those tendering considerable time and money, as their representatives would know at once how they stood, instead of spending several days attempting to get the information.

Every contractor includes in his estimates the cost of tendering before submitting his bid; consequently any condition that tends to increase the overhead of the contractor certainly tends to increase the cost of work to the city. At a time like the present, when the high cost of building threatens to tie up the industry for the time being, it is of paramount importance that everything possible be done to reduce costs, no matter how trifling it may appear.

Details in Design Not Properly Considered

AMUCH closer co-operation is required among mechanical and electrical engineers, architects and municipal authorities, and it has been our editorial endeavor in the past to promote to the greatest possible extent, this spirit of co-operation. The development of our engineering and construction fields has so allied the work of these various professions that the best results can only be obtained by co-operation.

For instance, many valuable buildings are constructed without due consideration being paid to their

exact requirements in heating, lighting, etc., and more satisfactory and economical results could be obtained by the collaboration and co-operation of specialists in the various branches of the work under construction. Another very important feature in the construction of a building for industrial purposes, and one that should not be left to the discretion of the architect alone, is that of future extensions. Due appreciation of the possible necessity of extending the plant requires the careful study of the engineer to provide for economic production as well as economy in design.

In recent years greater attention has been paid to the utilization of waste heat and energy, but there are many manufacturing firms who have not given this subject the attention it should receive and in the design of a new building it is more often than not completely overlooked, and the waste allowed to continue.

In industrial centres, heat which is allowed to go to waste might be advantageously utilized in heating industrial dwellings or individual institutions.

Wherever high pressure steam is used to generate power, the exhaust steam, when not used for industrial requirements or manufacturing processes, could be otherwise made use of.

These instances are merely used as an illustration of the many opportunities for the skilled specialist to work in conjunction with the architect in the development of an economic design. To secure economy in maintenance requires considerable experience and it will be readily realized what an important feature this is in determining the type of construction best adapted under the circumstances. Increased first cost will often result in a great reduction of upkeep expense which, in a very few years, will more than pay for this extra cost in building.

Eastern Ontario Good Roads Meeting

THE Eastern Ontario Good Roads Association will hold their annual meeting at the Chateau Laurier, Ottawa, on February 4 and 5. Mr. A. W. Campbell, Dominion Highways Commissioner, and Mr. W. A. McLean, Deputy Minister for Ontario, will address the gathering. They will also speak at the first annual dinner of the association to be held in the Chateau on Tuesday evening, Feb. 4, which will also, it is expected, be attended by a number of cabinet ministers, from whom interesting information is anticipated regarding the suggested co-operation of the Dominion Government and the various provinces in the work of highway improvement. Officials of other good roads associations in Canada have also been invited to be present and take part in the proceedings. Work, however, will occupy the greater part of the convention's time. Reports will be presented of the work done during the year, and also reports on the county road systems of each county in Eastern Ontario. In addition there is expected to be a great deal of discussion upon the location of various provincial county roads in the district.

The incorporation of the Eastern Ontario Good Roads Association has been applied for by Mr. C. J. Foy, K.C., its solicitor. The provisional directors will be the members of the present executive committee, namely: Wm. Findlay, president; John Brennan, first vice-president; Dr. T. W. Smith, second vice-president; W. F. Barker, third vice-president; W. Y. Denison, secretary-treasurer; C. J. Foy, W. J. Fisher, Bower Henry, A. M. Rankin, M. P. P.

Winnipeg Builders' Annual

End of War Marks Renewed Enthusiasm of
Members of Building Trade—Outlook Bright
for 1919—Officers for Ensuing Year

PERHAPS there is no trade in Canada that has been hit so hard by the war as that of building. Ever since 1914 there has been a slump in construction work, consequent upon a general tightening of the purse strings of the Dominion government, provincial governments, municipal authorities, and private enterprise. Loans were found almost impossible to float, and as a result building work was cut down to a minimum. Conditions in 1914, 1915, and 1916 were reflected in the returns of the building permits for Winnipeg. In 1912 these totalled over \$22,000,000, falling to \$12,000,000 during 1914. In 1915, when pessimism was very great through reverses of our armies in France, the building trade in Winnipeg slumped very seriously, the permits for that year dropping to the remarkable low level of \$1,800,000, or a decrease of \$21,000,000 over those of 1912. The building permits figures have gained only slightly during 1916, 1917 and 1918, last year's figures being just over the \$2,000,000 mark, which is looked upon by Winnipeg builders as the low water mark for many years to come.

The annual meeting of the Winnipeg Builders' Exchange, which was held on December 27th, at the Fort Garry Hotel, was therefore of more than the ordinary interest, as the period of reconstruction is about to make itself felt throughout Canada, by a renewal of construction work long delayed on account of uncertainty and lack of finances.

President of Exchange is Optimistic.

Over 200 members of the Exchange were present at the annual meeting which was presided over by president H. T. Hazleton, who, in presenting his annual address, spoke of how the four years of war had affected the building and allied industries to such an extent as to practically suspend building operations in the four Prairie Provinces since 1914. In discussing the outlook for the future, he saw real optimism for everybody in a renewal of construction work all over Canada, and in this respect, Winnipeg and Western Canada would receive its share of prosperity. The Dominion and Provincial governments, Mr. Hazleton asserted, were going to take the lead in starting the ball rolling, the former by appropriating \$25,000,000 for a better housing scheme, and the latter by co-operating with rural municipalities in starting work on public works which have been held over until the end of hostilities. The rural municipalities alone are one billion dollars behind in their construction programmes. Immigration, too, is sure to be heavy to Western Canada, and the present scarcity of houses and office buildings in the Prairies will mean much building along these lines. Taking everything into consideration, Mr. Hazleton believed the situation for 1919 and 1920 was such that every builder could have confidence of good business and at good prices. The days of the speculative and jerry builder passed into the great beyond with the advent of war. Those remaining will reap the benefit of staying on the job through these four lean years.

Mr. Hazleton then outlined what the Exchange had accomplished during the year, making a detailed

report of the meetings of the board. He reported that the finances of the Exchange were in a very healthy state.

In discussing the relation between Trade Unions and the Exchange during 1918, he made reference to several agreements that had been carried out successfully with unions during the year.

The president also mentioned the part that the Winnipeg Builders' Exchange had played respecting the Workmen's Compensation Act of Manitoba, the exchange being primarily responsible for the appointing of the Royal Commission to investigate this matter.

Mr. Hazleton now spoke for a few minutes dealing with the Fair Wage Board, showing the members how the Exchange had managed to persuade the Government to change the meeting of the Fair Wage Board from September to March in order to meet existing building conditions early in the year.

"The Winnipeg Builders' Exchange," said Mr. Hazleton, "was responsible for the formation of a Citizens' Alliance League, from which had sprung the present influential Board of Trade, which is the leading live-wire business institution of Winnipeg. In this connection it is of interest to know that one of our members, Mr. W. H. Carter, a late president of our Exchange, was honored by being elected the first president of this Organization."

The chairman of the different committees now presented their annual reports on the year's business as affecting their individual section. Reports were heard from the chairman of the following committees: finance, membership and entertainment.

Red-Letter Resolutions.

There are in the process of formation certain resolutions which will be of great benefit to members of this Exchange. One will simplify matters where the contractor is dealing with the sub-contractor and material dealers of the Exchange. Another will help the material and sub-contractor in his relation with the general contractor, and a third will have reference to the promotion of better feeling of members insofar that they will not interfere with each other's work while on any job.

New Officers Elected For 1919.

The election of officers for the ensuing year resulted as follows: President, H. T. Hazleton (re-elected); 1st vice-president, John Sutherland; 2nd vice-president, N. W. Warren; treasurer, T. D. Robinson; secretary, J. S. Hooper. Directors, retiring in 1919: J. H. Schumacher, electrical section; W. H. Hilton, asbestos section; P. Muir, general contractors' section; A. G. Matthews, marble and tile section; F. Dowse, mill and interior section. Directors retiring in 1920: James Mackie, plumbing section; J. A. Marion, building supply section; H. Eager, paint and glass section; L. R. Barrett, structural steel section; Chas. Dure, lumber section. Directors retiring in 1921: J. W. Morley, painters' section; F. Foxcraft, sheet metal section; Wm. Macartney, plaster section; Wm. Allen, art stone section; A. J. Bonnett, general contractors' section.

The guests of the evening were Major F. H. Davidson (who is an ex-president of the Exchange), W. H. Carter, president of the Board of Trade, and W. B. Moore, secretary of the Board of Trade. Each delivered an interesting address which was well received

by the members. Of particular interest was the address of W. H. Carter, who was a president of the Exchange a few years ago. Mr. Carter was exceedingly optimistic in his remarks, concerning the outlook of the building and allied industries in Western Canada. His remarks were along the lines of the article of this gentleman which was published in the December issue of the "Contract Record."

The evening, which started with a banquet, concluded with a social hour, when the members enjoyed a game of cards, a few songs, and a recitation by John Coyle.

Bonspiel on January 21, 22 and 23.

Secretary Hooper has announced the dates of the annual bonspiel to be January 21, 22 and 23. The bonspiel will be held at the Granite Curling Rink, Winnipeg, and the executive anticipates 56 rinks to enter this year against 46 last year.

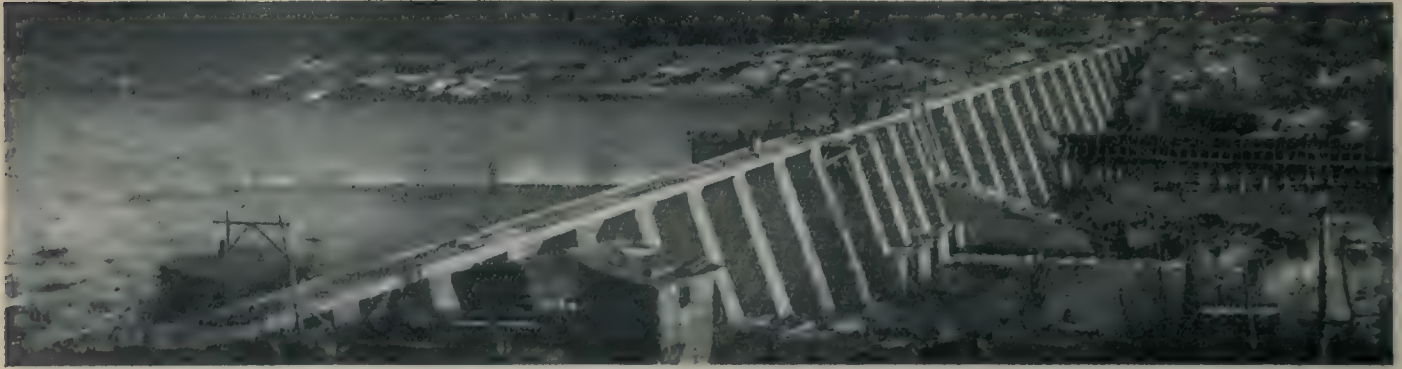
Imperial Oil Co. Takes Further Measures to Promote Employees' Welfare

The Imperial Oil Company has made arrangements to insure the lives of all employees who have been in the service of the firm more than one year. This measure takes effect from Jan. 1, 1919, the business being handled by the Equitable Life Assurance Society of the United States. Employees who have not been with the company for a full year will be insured as soon as they have completed that term of service. The amount of insurance will be graded according to earnings and length of service, with a maximum of \$2,000. On February 1, a plan of old age pensions will also become effective, and on March 1, a sickness benefit plan—all these to be administered by a committee to be known as the annuities and benefits committee, under the direction of the board of directors. No medical examination is required for insurance, and the entire expense of the various schemes is to be borne by the company.

Snow Removed at Buffalo by Prison Labor

Prisoners from the county jail were employed by the city of Buffalo, N.Y., in snow removal work in the winter of 1916-17. The prisoners were placed on the outskirts during the day where streets were drifted, being impassable for fire protection, vehicular traffic and pedestrians. At night they were placed on the down-town streets. They were furnished with warm gloves, caps and rubbers, and in some cases where prisoners did not have warm underwear it was furnished to them. They also were given tobacco every other day, furnished with pipes or cigarette papers, and their lunch and hot coffee were carted to the places where they were working. On the outskirts salamanders were kept going for warming the men and also for keeping the coffee hot. The prisoners were paid 25 cents per day, which was given them upon their discharge. The report of the Bureau of Streets estimates that the city saved over \$15,000 through the work done by the prisoners.—Engineering and Contracting.

The annual meeting of the Montreal Builders' Exchange will be held on January 27th.



Hollow Concrete Dam at the Outlet of Lake St. Francois

By O. Lefebvre*

THE river St. Francois is a tributary to the St. Lawrence River, into which it flows at the head of Lake St. Peter, about fifty miles from Montreal. It has a drainage area of 3,900 square miles, which comprises a large part of what is known as the Eastern Townships of the Province of Quebec. It has the shape of a large T: from its source at Lake St. Francois, in the county of Frontenac, the river runs south west for a distance of sixty miles as far as the town of Lennox, in the county of Sherbrooke; then it turns about ninety degrees to a north-east direction, and runs through the towns of Sherbrooke, Richmond and Drummondville.

The level of Lake St. Francois is about 900 feet above that of Lake St. Peter. The distance is about 120 miles. This difference in elevation is found in numerous falls and rapids, most of which have been developed for manufacturing purposes. The principal water powers which are now in use are the following:

	Developed Head
St. Francois Hydraulic Company, at Disraeli, Champoux Co.	40
City of Sherbrooke, at Two Mile Falls (total available 88)	20
Brompton Pulp & Paper Co., at East Angus	30
Brompton Pulp & Paper Co., at Bromptonville	55
Canada Paper Company, at Windsor Mills	30
Southern Canada Power Co., at Drummondville	16
	12

The discharge of St. Francois river varies considerably in short periods. The minimum in winter time is usually very low and the water power owners were at a great disadvantage. A request on their part to the Quebec Government for storage works was referred to the Quebec Streams Commission, which was authorized at the Session of the Legislature in 1915, to create in Lake St. Francois a storage reservoir of a capacity that will store all the water supplied by the basin of that lake.

Lake St. Francois has a drainage area of 472 square miles; the lake area is 13 miles at low water, and will be practically 20 miles when the storage reservoir is full.

This reservoir necessitated the construction of a

dam at the outlet of the lake, capable of raising the waters to a maximum level of 27 feet above the minimum low water of the lake.

Dam Site

The dam site is located between lot 9 in the township of Price at the south end of the dam, and lot 10 in the township of Coleraine at the north end. The nature of the soil of the foundation is practically hard pan,—that is, a mixture of clay and small stones. Numerous wash-borings and five test pits showed that the depth of this material was over 48 feet. The ground is very hard and had to be excavated by pick and shovel. It was impervious to water. It was decided that a concrete dam could safely be built over such material. The dam is of hollow concrete consisting of a floor slab properly reinforced and supporting thirty-two buttresses which support a deck slab. On top of the dam is a roadway ten feet wide. The dam is 602 feet long from outside to outside of end buttresses, besides two wing walls extending 45 feet at each end.

Excavation.—Before any concrete was poured the foundation was excavated to a depth, so that the total thickness of the slab was embedded into imper-

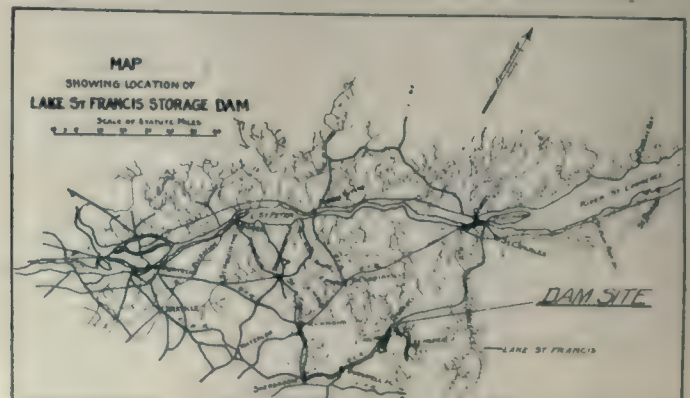


Plate 1.—Showing site of Lake St. Francis Dam

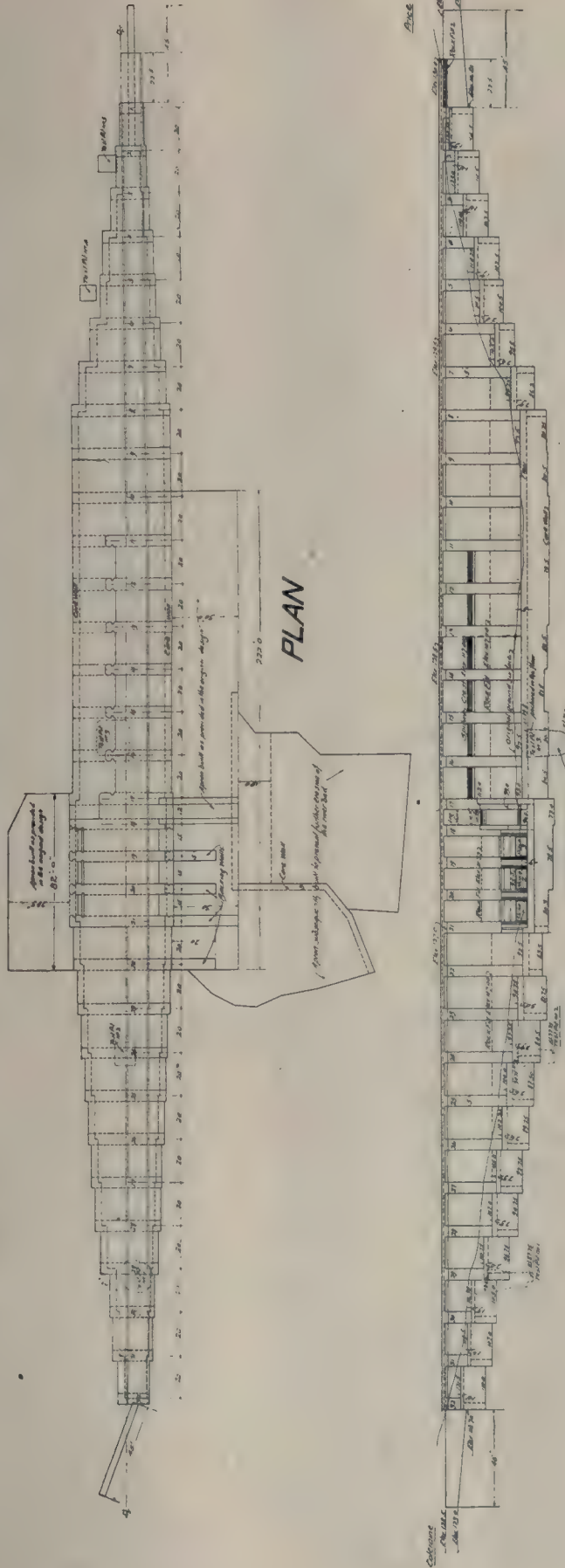
vious material. This required that the excavation be carried down to a depth five to six feet below the natural ground surface.

The excavated material was hauled by bucket and cable-way to a point outside of the dam site.

Cut-off Walls.—In order to insure against leakage under the floor slab two cut-off walls have been pro-

*Chief Engineer of the Quebec Streams Commission.

Plan, Elevation and Typical Sections, St. Francis Dam



DOWNSTREAM ELEVATION

Plate II.—Plan and Downstream Elevation, St. Francis Dam—Part of Conservation Scheme of Quebec Streams Commission.

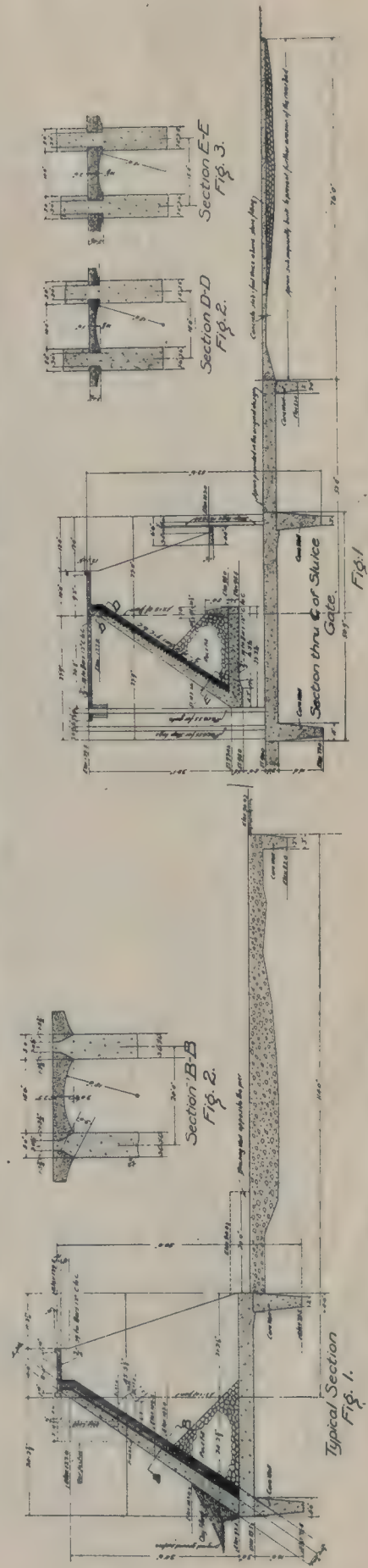


Plate III.—Typical Section of St. Francis Dam

Plate IV.—Section through centre line of Sluice Gate

vided, one at the heel and the other at the toe of the dam. The specifications called for these walls to be of a depth of ten feet below the bottom of the floor slab and a regular width of three feet. But, during construction, it was thought advisable to make the walls four feet wide on top and two feet wide at the bottom, this section making the trench work much easier and it being considered just as efficient as the original section. The bond between the slab and the up-stream cut-off wall is provided by stones partly embedded into the concrete of the wall and into the concrete of the slab. The bond between the slab and the downstream wall is provided by building the slab partly below the top of the wall.

Floor Slab.—The floor slab has a thickness which varies from 15 inches, between elevation 122 to 127, to 36 in. between elevation 87 and 92,—it being increased three inches for every step of five feet downwards. Its width varies according to the depth, its minimum being 11 feet, 3-3/8 inches and the maximum 48 feet.

This floor slab was reinforced longitudinally with 3/4-inch square, steel-twisted bars, spaced from six to four inches. These bars were placed three inches from the bottom of the slab under each pier for a distance of eight feet, and then bent and brought up to within three inches of the top of the slab for nine feet of the central space between the piers. This deck slab was built horizontally and stepped down according to the elevation of the excavated material. Plate 2 shows how the steps were arranged.

The concrete for this section was mixed in the proportion of 1: 2 1/2: 5.

Buttresses.—The buttresses are five feet thick from top to bottom. Their top width is ten feet from ele-

was added an average of 20 per cent. of boulders, well cleaned and wetted.

The up-stream face of the piers was shaped to support the deck slab.

On the lateral faces of the buttresses and at their up-stream face, there was provided seats of the shape and dimensions shown on Figure 2, section B-B, Plate 3, to support the deck slab.

The piers at the gate section were provided with a stop log recess near their upstream end, 13 inches wide and 12 inches into the piers. Their downstream end is vertical from elevation 90 to 102 and they are also provided with stop log recesses.

Log Sluice Section.—Between piers 17 and 18, which are but twelve feet centre to centre, there was provided a log sluice opening seven feet wide,—the sill of which is at elevation 111.75. There is no deck slab between these two piers, but, instead, a block of solid concrete was poured bodily with the concrete of the piers. The concrete in this block and in the two piers was poured as a unit, the forms being arranged accordingly. The upstream face of the block corresponds with the place of the pressure slab, and the downstream face is vertical.

A deck laid along curved lines and properly reinforced, spans the seven-foot distance between the piers to a distance of 30 feet downstream to the toe of the dam. This log sluice opening is closed by a wooden gate which is operated from the top by a rack and pinion.

A permanent opening of 5 feet had been purposely left in the lower part of the sluice, as it was thought that it would be necessary to allow a certain amount of water to flow continuously. However, it was found this year that the dam could be completely closed on

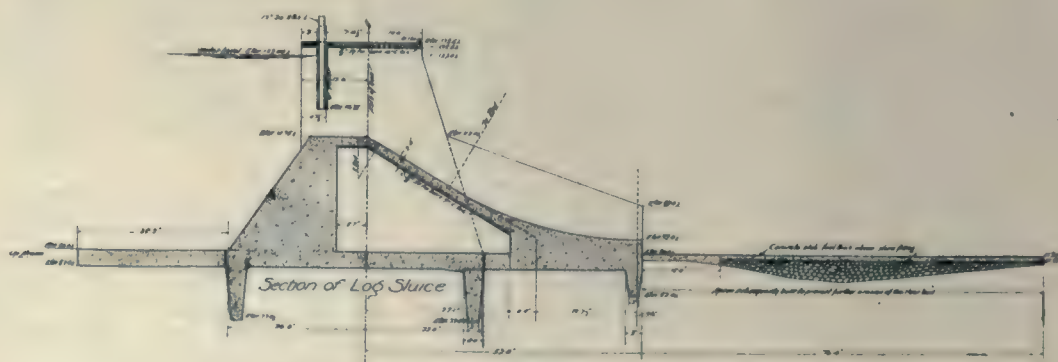


Plate V.—Section of Log Sluice, St. Francis Dam

vation 130 to 127: from this point, they slope up-stream in the proportion of 26 feet horizontal to 37 feet vertical and, at the downstream, the slope is in the proportion of 12 feet to 37 feet. The maximum bottom width is 48 feet. The piers are 20 feet centre to centre, except at the gate section where four piers have their upstream face vertical from the floor slab to the top of the dam and are spaced fifteen feet, centre to centre.

The concrete for the piers was brought to the forms in a bucket carried by cableway, and deposited on a platform from where it was dumped into the forms. The platforms were arranged at different elevations, so that the height to which the concrete had to fall through the air would not permit the aggregates to separate. The concrete for the buttresses was mixed in the proportion of 1:2 1/2: 5, and there

every Sunday and plans have just been completed to close the sluice completely whenever desired.

Sluice Gate Section.—Three sluice gate openings were provided, each ten feet wide by five feet high, and each closed by a wooden gate which is operated from the deck slab by worm gearings connected to a lifting arm.

Weir Section.—A waste weir section has been provided, extending between piers 17 and 11, comprising six spans of 15 feet each, the sill of which is at elevation 117. The upstream face of the piers is vertical from elevation 114.25, and the top of the piers is 19 feet wide. The openings in the weir are closed by stop logs of B. C. fir 12 in. x 12 in. and 17 feet long.

The two spans adjacent to the log sluice have been provided with a slope on the downstream end, to direct the water to the lower pool and prevent its fall-

ing freely on the floor slab. These are also used for sluicing the logs.

Deck Slab.—The deck slab which spans the space between all piers, rests on a seat prepared on the upstream face of the piers. This slab is a crown on the pressure face, but is an arch on the downstream face. The arch is along a curve of 75-foot radius from top to bottom.

The thickness of the slab varies at the crown of the arch from 1½ feet at the top to three feet at the bottom measured normally to the arched face. No steel reinforcement was placed in the arches. The concrete was mixed in the proportion of 1:2:4 and no boulders were allowed to be added.

The deck slab in the sluice gate section was reinforced. Owing to its special connection with the piers, it was figured as acting like a beam and not as an arch.

Roadway.—On the top of the dam a reinforced concrete roadway was built, extending at the weir section and the gate section to the stop log recesses.

The bed of the river has been protected from erosion upstream, from the gate entrance, by a concrete floor slab three feet thick and extending 30 feet above the dam and, on each side to the pier next to the gate pier.

On the down-stream part of the river, a concrete slab was originally provided, extending across the river from pier 21 to pier 10,—a distance of 202 feet, and over a width of 30 feet, but this proved insufficient as the bed of the river was eroded at the time of the flood of June, 1917, and concrete was poured in the excavation made for a distance of 90 feet from the toe of the dam. This erosion took place before the concrete apron had been completely poured. The filling of the river bed was made with concrete mixed in the proportion of 1:2 1/2:5, into which was added about 40 per cent. of boulders.

In 1918, further erosion in the bed of the river took place at the outlet of the log sluice—the loose stone protection which had been provided there was not sufficient. The hole made was filled with stone, over which was poured a layer of concrete one foot thick.

The safety of the dam against sliding and overturning was determined by assuming that the weight of the concrete was 140 pounds per cubic foot and that of the water at 6½ pounds per cubic foot, and an uplift pressure acting with 100 per cent. of the head at the heel of the dam and gradually decreasing to zero at the tip of the dam. Further safety against sliding was provided by butting the floor slab against the down-stream cut-off wall.

The dam was designed by the writer. The contract was carried out by Mr. Geo. Madden of Quebec, the contract price being \$101,000.00, with \$19,000.00 as extras.

A One Course Sidewalk

One-course concrete sidewalks finished with a roller and wood float came as a natural sequence to the construction of millions of yards of concrete roads throughout the United States, reports Engineering and Contracting. So simple is the method of construction and so successful the results that it is surprising more extensive use has not been made of its opportunities for saving labor and improving construction.

Two-course construction involves the mixing of concrete of two proportions, sometimes results in separation of top course from the base and offers oppor-

tunity for the unscrupulous contractor to skimp the base.

The one-course type was decided upon for the subdivision of the American Steel & Wire Co. at Donora, Pa., where an extensive concrete housing development is being completed. Contract was let for approximately 25,000 sq. ft. of 5-ft. walk, 4½ in. thick. The work was handled in much the same way as one-course concrete road construction.

Of special interest are the steel dividing plates used to separate concrete into 5-ft. slabs, as the plates must not extend above the sidewalk surface if the roller method of finishing is to be followed. Since it is difficult to cut through one-course concrete with a trowel or even to groove the walk deep enough to make sure that the concrete will separate where marked if contraction or settlement occurs, some type of dividing plate is necessary.

Where wooden side forms were used, 3-16 in. steel plates 5 ft. long by 4½ in. in depth were spaced at 5-ft. intervals. Near the top at each end of the plate a small hole was provided so that the plate could be removed with hooks. To prevent concrete from pushing these plates out of position, they were staked near the ends and at the centre with steel pins.

On part of the work the forms were of steel. The type of dividing plate used with these patented forms had a projecting part in the shape of a hook on each end which fitted over the vertical web of the channel-shaped side form, the upper flange being cut through to make that possible. Only one stake on level ground, or two on grades, were needed with this type of plate.

Concrete was mixed in proportions of 1:2:3, using crushed blast furnace slag ranging in size from ¼ in. to 1½ in. as coarse aggregate. This gave particles larger than are ordinarily used in sidewalk construction, but little trouble was experienced from this cause when the concrete was finished with a heavy roller.

Care was taken to have adequate provision for expansion. Every 50 ft. a strip of prepared filler ½ in. in thickness was placed across the sidewalk, and where the walk abutted a street curb two thickness of filler were used. Between houses and walks a ½-in. joint was placed.

Concrete was deposited directly on the clay subgrade and struck off ½ in. high with a template. Following this, concrete was rolled longitudinally with a 10-in. roller 5 ft. 5 in. long, which weighed 2¼ lb. per lineal inch. Since this roller rested on the side forms after concrete had been compacted to the proper level, it was satisfactory although heavier than is used ordinarily. Immediately after rolling the surface was finished with wood floats, dividing plates were removed, joints grooved and the sidewalk edged.

The concreting crew was made up of 14 men, including the superintendent; five men were employed in the mixing crew, three wheeled concrete, two set forms and three did the finishing. Twenty-one hundred square feet was the largest day's work done; while 1,800 sq. ft. was a fair daily average. The mixer was a two-sack batch side dump machine. Usually it was moved four times daily.

A concrete mixing machine can be conveniently arranged to drive a hoisting rope to operate an elevator delivering cement bags or aggregate to an elevated charging platform as was recently installed on a job at Edison Park, Illinois, by R. F. Conway & Co., Contractors.

Erecting a Building of Pre-Cast Concrete Units

THE unit system of construction in reinforced concrete work has often been discussed, but the application has seldom been carried out in practice. This system has many advantages, as it minimizes the use of timber for form work, bracing, etc., and also facilitates erection.

A building erected for the Birmingham Small Arms Co., Limited, England, is described in the Architects and Builders Journal. The columns, beams and trusses are first cast as separate units on the ground and then erected after the manner of a steel frame building.

Size of Building

The building, which is 640 ft. long, 200 ft. wide, and 14 ft. 3 in. high to underside of roof trusses and lighted from the roof, is divided in both directions into 20 ft. bays, with the exception of one bay, 205 ft. long, 40 ft. wide, and 26 ft. 6 in. high, made to accommodate a five-ton overhead travelling crane.

Units Cast on Ground

The units are cast flat on the ground as near their final position as is found convenient. A level site is chosen on which the centering, comprising the bottoms and sides of the unit is laid. The shuttering is easily made in such a way that it can readily be put together or taken apart without damaging the timber by nailing, etc., of disturbing the concrete by forcible prising at removal. The reinforcement is then placed in position and the concrete poured in the usual manner, the top surface being trowelled smooth. After the lapse of a few hours, oiled paper is laid on the finished concrete, timber sides are placed on the top of the first set, and another unit is cast, this operation being repeated until a stack of about seven units is made.

Ageing Units

The concrete is, after a few days, sufficiently hardened for the timber sides to be removed. The shuttering, when cleansed and oiled, is ready for the casting of a further set of units. It is obvious that a great economy of timber is effected, as the centering is repeatedly re-used at comparatively short intervals. Moreover, the use of wooden props, required to hold up the concrete structure until it is strong enough to support itself is dispensed with altogether. The mo-

nolithic character, so peculiar to reinforced concrete buildings cast in situ, is to some extent, lost in this method of construction, although it will be shown that in the case of junctions of beams and columns, this loss can be reduced to a minimum by careful design.

Pouring Concrete in Cold Weather

A large portion of this work was performed during the winter, and a method had to be devised to warm the concrete and prevent freezing in cold weather. A

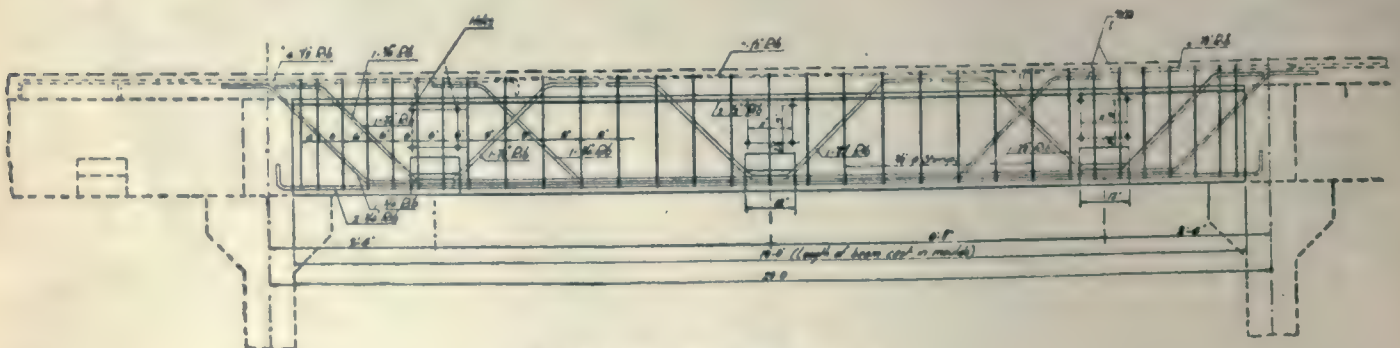


Interior View of Building

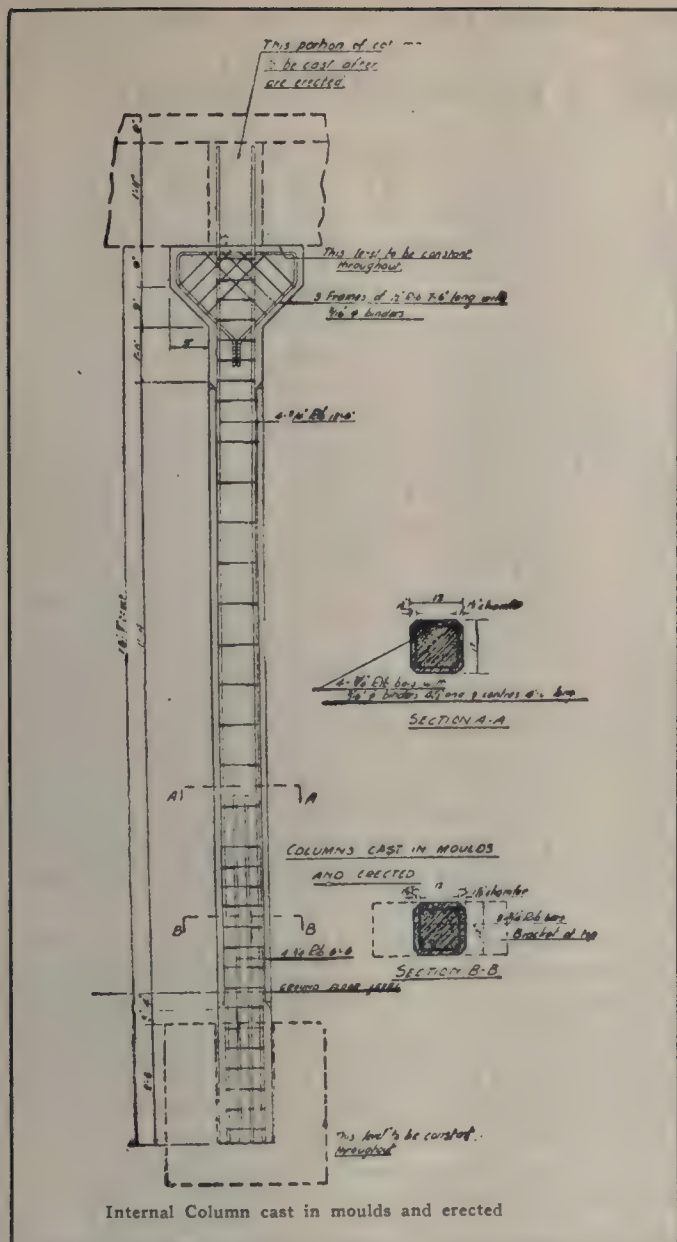
steam pipe was taken from a portable boiler along the ground and T's and loop pipes passed from it to the place where the concreting was being done. As the casting advanced to a higher level, loops were lifted to the same level, and the concrete was thus prevented from freezing before setting.

The cost of warming was negligible, and the system enabled the builders to continue work throughout the cold weather, which would otherwise have been impossible.

A unit is considered to be strong enough for the handling when it is a month old, but the period of



Main Beam cast in molds and erected



Internal Column cast in moulds and erected

hardening would naturally vary with the conditions of the weather.

The column bases, which are, of course, cast in situ, are 3 ft. square and 3 ft. thick, with a socket in the middle 2 ft. 3 in. deep to receive the columns. Details of the beam and column construction are shown in the accompanying illustration.

Erecting Units

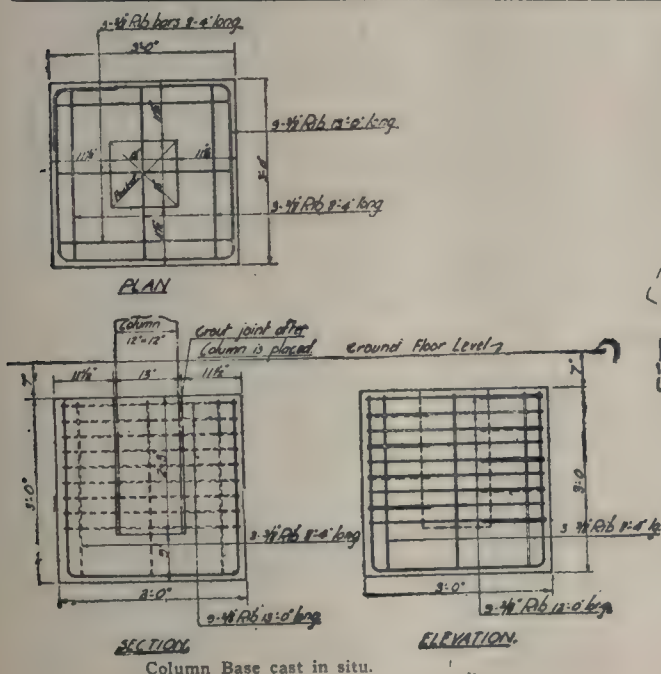
The columns are 12 in. by 12 in. section with two 9-in. brackets on the top to carry the main beams. The columns are dropped into the base sockets, plumb-ber vertical, and then grouted in with cement.

The main beams, although cast as units, are designed as continuous beams. The continuity is obtained by the addition of 6 in. concrete and reinforcing steel after the unit is placed in position. When erected, the beams are 8 in. wide and 1 ft. 11 in. deep, with protruding stirrups on the top, but when completed they are 6 in. deeper. The end of the beams are not laid to butt on the top of the columns, a space of 12 in. being left between them, which is afterwards filled in with concrete, projecting reinforcement from the beams and columns, and the additional steel and concrete on the top before mentioned affording a means of binding the whole together, thus making it practically monolithic. An elevation and section of beam are shown in the illustration.

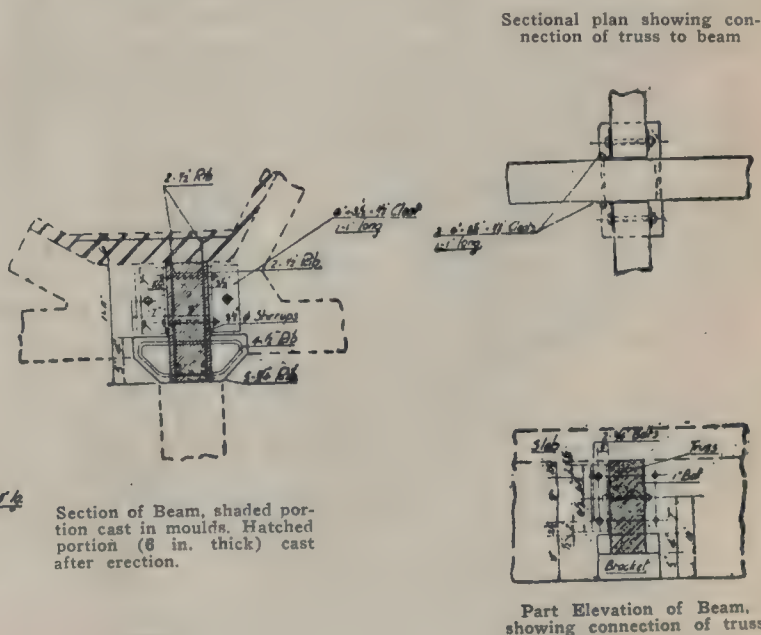
The concrete trusses are of the usual north-light type, spaced at 6 ft. 8 in. centres resting on 9-in. by 12-in. brackets, cast on the beams for this purpose.

They are secured to the beams by steel angle cleats bolted through holes cast in the trusses and beams for that purpose. It was considered desirable to tie the trusses together to resist wind pressure, and this was accomplished by laying $\frac{3}{8}$ -in. Kahn rib bars diagonally across two bays of trusses, buried in the roof slab and bent at the top and bottom around short bars projecting from the backs of the trusses. At the ridge of the roof the slab is thickened to 6 in. to give lateral stiffness.

The illustration gives an excellent idea of a completed portion of the interior, with the perfect lighting obtained, while in the distance can be seen the crane bay in course of erection.



Column Base cast in situ.



Sectional plan showing connection of truss to beam

Section of Beam, shaded portion cast in moulds. Hatched portion (6 in. thick) cast after erection.

Part Elevation of Beam, showing connection of truss

Engineers for Highway Work

By John H. Mullen, Engineer and Deputy Commissioner, Minnesota State Highway

THE country evidently has become aroused to the need for highway improvement and is willing to spend millions of dollars for that purpose, provided there is assurance that the work will be properly handled. The public, however, does not know how this should be done, and has but a very hazy idea of the need for scientific organization and expert supervision of highway improvement. The engineer's work in France and the progress already made in this country has, to a certain degree, opened the eyes of the public in this respect, but there is little known of the careful investigations, the close study, the hard work and the infinite amount of detail attendant upon the successful prosecution of highway improvement. In the public mind, satisfactory results are generally credited to the contractor or superintendents of the work, who do not consider it unethical to advertise. This matter of publicity is very important and the people should be well informed on the management of highway affairs so that the engineers will be given due credit for their work.

Inadequate Pay of Highway Engineers.

Highway administration offers a great field for engineers, but this will not be developed unless it is possible to pay adequately for engineering services. This has not generally been done. Many states have worked up very efficient organizations and have been obliged to maintain them at a low expense on account of lack of funds. Some of these departments are held together through interest in the work and loyalty to the service, but this is a practical age, and if the proper kind of men are to be employed, if initiative is to be encouraged and efficiency promoted there must be a material reward. In the past few years it has been the experience of many engineers to have had charge of work on which the foreman and machine operators were drawing 50 to 100 per cent. more pay than the engineer. Knowledge of this does not create respect for the profession by those employed on the work, nor does it increase the engineer's self-respect and confidence in his position of authority. Highway engineering requires as much training, experience and application as dentistry, or the law, and as a profession, is held responsible for the condition of the public highways which are the main arteries of business in the country, and which affect the individual and community more intimately than any other public work. Therefore in the light of fairness and good business this profession should also be recognized by proper compensation, otherwise it will be difficult to interest able engineers in the work.

Qualifications of a Highway Engineer.

The qualifications for a highway engineer do not seem to be generally agreed upon. It is frequently stated that this position requires only from 10 to 25 per cent. technical knowledge and the remainder common sense. The natural consequence of such statements is to mislead the public and discredit the profession. It is true that the work requires the exercise of a great deal of common sense, but that is fundamental and true of any other important work. The

highway engineer must have a ground-work of engineering knowledge, acquired through years of practical experience and study or by technical schooling. Without advanced technical training a man is greatly handicapped in engineering, but on the other hand, experience proves that men who have overcome this handicap are generally the most efficient. Highway engineering is a new science, in the process of development, and the man who can accumulate and systematize knowledge of this subject as it develops, will make a successful highway engineer, provided he has the preliminary training or engineering experience as a foundation. Actual training in this branch of work has not given engineering colleges much concern up to the present time, which, however, is not a serious matter, for traffic conditions have changed so radically in the past few years that the principles involved are entirely different. We are now at the opening of a new transportation era and the volume and importance of contemplated highway work calls for the special training of a large number of men. At the same time it is realized that engineering colleges are not generally equipped to give this training and therefore it falls upon the State Highway Engineers to lend assistance in directing the work of the students so that upon leaving college he will not have to serve such a long apprenticeship before taking charge of work.

To efficiently perform the duties of highway engineer requires not only technical qualifications, but also knowledge of public affairs, administrative ability, capacity for detail and the knack of handling men. The engineer, devoting all of his time to the work, is in the best position to study traffic conditions, and the economics of the situation, to advise the governing boards, and direct public sentiment along proper lines.

There is a growing tendency especially in the western states in which highway departments have been organized for several years, to place the entire responsibility for highway management in the county upon the highway engineer. Boards of supervisors have other interests demanding their attention and are placed in authority primarily to carry out public policy and to protect the public interests. It is not expected that they are qualified to direct engineering operations and they gladly receive the co-operation of the engineer if convinced that it is co-operation and not interference which the engineer offers. But an engineer should not assume such responsibility unless he is willing to apply a tremendous amount of study and work to the task. He must make a study of the present and prospective tonnage and passenger movement on the highways, of the availability of road materials and shipping facilities, and also of the economical types of road and bridge construction to meet the various conditions, and must inform the people of their needs in such a way that funds will be provided to carry on the work. A survey and accounting organization has to be worked up so that adequate and complete plans and supervision will be provided and comprehensive cost data made available, also that traffic and service records may be kept, and all factors governing road policy and administration tabulated and orderly arranged.

*From a paper before the American Association of State Highway Officials.

Toronto Builders' Exchange Urges Forward Movement in Technical Education

A DEPUTATION of representatives from the Toronto Builders' Exchange and the Sheet Metal Industries, interviewed the Hon. Dr. Cody, Minister of Education for the Province of Ontario, by appointment on Monday morning.

The deputation, consisting of Mr. W. E. Dillon and Mr. H. Feather, of the Builders' Exchange, John H. Kennedy, International Representative of the Sheet Metal Industries, J. McKay and T. Mason, local trade union representatives of the sheet metal workers, were introduced to the Minister and to Dr. F. W. Merchant, Chief Inspector of Technical Education for the Province.

Mr. Dillon submitted a number of suggestions for discussion which were received with considerable interest and were dealt with as thoroughly as was possible at a first meeting.

It was suggested that all technical schools should be owned and operated by the Provincial Government. This was desirable from the point of view of the deputation in order to have technical education throughout the province under control and developed along broad practical lines. It was felt that in some of the technical classes the theoretical branches were developed at the expense of practical work. It was not intended to suggest that theoretical work should be neglected, however, but that sufficient practical work should be undertaken in conjunction with it to develop the student and secure the best results.

The sheet metal industry was one of the most technical of the building industries and apprentices to this trade were badly handicapped if they were unable to secure a suitable educational foundation to master the trade.

Dr. Merchant pointed out that the chief objection to this suggestion was that if the schools were under government control, the municipalities would lose interest and his experience was that the interest of all people concerned must be secured in order to make success certain.

That the Dominion Government be asked to give financial aid for technical education was passed without question; in fact Dr. Cody stated that he felt assured the Federal grant would materialize. Anything that could be done, should be done, to foster public opinion to spend more money on education. This money should be granted without a string attached. The chief expense would be for buildings and equipment.

The third suggestion was that the parent or guardians of boys should decide the vocation to be followed by the boy when the latter is 16 years of age. It was felt that no decision should be made before the boy had arrived at this age.

Compulsory education for boys between the ages of 14 and 20, either by day or night classes, or correspondence courses, was considered essential if the necessary progress was to be made. The educational course should be of the kind most likely to benefit the student in his life work.

It was suggested that an apprentice committee

could be appointed and that the teachers of manual training and technical subjects should have sufficient practical experience to satisfy this committee as to their ability, before being appointed to the teaching staff.

Mr. Dillon said he had no doubt but that manufacturers would arrange to place their shops at the disposal of the schools for practical evening instruction, if such a course was considered advisable. Mr. Mason stated as his opinion that a certain preliminary education was necessary to qualify for entrance to technical classes.

Dr. Merchant said that the local school boards decided what courses were necessary to meet the local requirements. In any field of a practical character, for which there is a need, it would be possible to arrange classes to cover this need. In appointing instructors at present, practical experience was an essential qualification, but it was very difficult to secure the services of satisfactory instructors.

One very serious difficulty pointed out, was that obtaining in small places where there were only two or three boys in a certain class—certainly not sufficient for a special instructor. Mr. Dillon stated that, at present, these cases were dependent on a correspondence course which cost considerable, and questioned if it would not be possible for the government to establish a school offering technical courses by correspondence at a cost that would be no great burden to the student.

The question of compulsory education up to the age of sixteen years, was suggested by Dr. Merchant, and caused considerable discussion.

In closing, the Minister expressed himself as very pleased with the ideas brought forward and assured the delegation that he would greatly welcome their efforts to improve the facilities for technical education, and would also appreciate any suggestions they cared to submit for consideration at any time. Summed up, the suggestions of the delegates were as follows:

1. All Technical Schools to be owned and operated by the Provincial Government.
2. That the Dominion Government be asked to give financial aid for technical education. (See Dr. Robertson's report).
3. That the parents or guardians of boys shall decide the vocation the boy is to follow. This is to be decided when the boy is 16 years of age.
4. Compulsory education for boys, between the age of 14 and 20, either by day or night classes or correspondence courses.
5. That the educational course should be of the kind most beneficial to their future vocation.
6. That the teachers of manual training and mechanical development shall have mechanical skill, and shall be appointed by a committee known as the apprentice committee.

Repatriation and Employment in Connection with the Reconstruction Work of the Government—First Official Announcement

THE Hon. J. A. Calder, Minister of Immigration and Colonization, addressed The Canadian Club at a luncheon on Friday last on the subject of Repatriation and Employment in connection with the reconstruction work of the Dominion Government.

This was the first official announcement of the Government's policy on this subject and one that has aroused considerable interest and speculation all over Canada.

In opening, the speaker stated that we had just come through a long hard struggle, and pointed out that we have accomplished, in proportion to our population, as much, if not more, than any other nation engaged in the war, and have sustained our war effort in a most efficient manner from the time our soldiers first went overseas until they rested in the historic city of Mons on the day the Armistice was signed.

The armistice changed the situation over night, and many plans had of necessity to be completely altered. The people were war weary and exceedingly anxious to get back to pre-war conditions. There was a great tendency to grumble, and many were in doubt as to whether the Government was ready to handle the many and difficult problems that confronted it to-day. They are asking if all necessary plans and preparations have been made, and are anxious to learn just what is taking place at Ottawa.

The speaker was too much of a politician to neglect to take advantage of the opportunity to refute the rumors of discontent said to prevail at Ottawa. So far as he could see, and in his judgment, there was nothing to give any indication of a smash likely to result in a general election. Realizing the tremendous task confronting the country, every member sees that it would be little short of criminal to force an election or play politics in any way. He was emphatic in his expressed opinion that there should be no election in Canada until the soldiers from overseas are all back home and able to have a voice in the matter.

Reconstruction

In reference to reconstruction, he stated that the name implies a great deal, considerably more in some other countries than it did in Canada, where there were no devastated areas to be reconstructed. Canada was entirely different to what it was before the war. Our people, as a result of the war, are thinking differently; there is more independence of thought. The people's hearts and souls have been touched as never before, and he was certain that the old conditions could never be resumed. The people had awakened to the fact that they must take a vital interest in public affairs. Heretofore many had bowed to party, but from now on there is evidence that party influence had lost its power, and that the people will decide the class of government for the country and the policy it puts in force.

Canada has been stagnant as far as policy is concerned, but we are awakening to the fact that a new policy tending to the betterment of the people and the development of the country must be put in force as soon as possible.

The question of labor disturbance was touched on briefly. In the speaker's opinion there was no chance for Bolshevism in Canada. It only existed in a very

small way and there was no possible chance for it to develop. There would be no upheaval, but everyone must be ready to play his part.

The immediate problem was connected with the men overseas. Besides the 250,000 soldiers there were in the neighborhood of 50,000 soldier dependents—wives and children. This figure was constantly increasing, owing to the rapidity with which our boys were marrying old country girls and in addition the increasing arrival of babies. The maximum number it is possible to bring to Canada each month is 30,000. This figure is determined by two factors, shipping and railways. It might be possible to increase the number of transports, but the railways of Canada could not possibly, with all their facilities, handle any more. At this rate it will be ten months at least before all can be brought home. Arrangements have been made to handle the work as expeditiously as possible, but owing to the fact that the job is such a big one and so many are involved in the necessary organization, some mishaps are bound to occur. When all is considered there is little cause for complaint.

The return of the troops is only a small part of the problem. The big part is in using every effort to put each soldier back into civil life under conditions even better than those under which they lived before the war. The Government and its chief officials have given the subject a great deal of thought and study and have made much progress. Many thousands have already been attended to and it is merely continuing the work on a much larger scale.

Demobilization

The plans had all been arranged and the details all carefully worked out in connection with the work of demobilization, but the armistice altered the whole situation. The boys refused to come home the way planned for, so other ways and means had to be devised.

General Mewburn is the authority for the statement that all details for the revision of demobilization plans have been worked out satisfactorily. In all the problems arising, both in war and peace, the Government had no precedent to guide them in any way.

Soldiers' Settlement

No more difficult problem has arisen than that of soldiers' settlement. Canada was a large country and the conditions varied radically in different provinces. The proposal to give the men Crown land brought attention to the fact that in some instances the Federal Government owns the land, and in some cases the Provincial Governments. It was also found that there was not sufficient suitable available land and the proposal was made that the men be placed on purchased land not now being used. This land should be made available for the men instead of sending them to outlying districts on the fringes of settled districts. Legislation would soon be put in force, in both Federal and Provincial Governments to provide for this.

Much Accomplished

The public was prone to overlook the work done by the Soldiers' Civil Re-establishment and Military Hospital Commission. It was realized that the State must take hold of our war-broken men and refit them for civil life. This has been done most satisfactorily for the past two years. In that time 3,000 soldiers have been treated, fitted, trained and placed in remunerative occupations. It should be called to the attention of all what a gigantic task this was. It necessitated the erection and equipment of buildings as well as the or-

ganization of a technical staff. The result has been excellent when all difficulties have been considered.

Employment

The Dominion and Provincial Governments have organized and established 30 labor bureaus in various parts of the country. It is the intention to open 34 more, making in all 64, to secure employment not only for soldiers, but for the civil population as well. This expense is borne half by the Dominion and half by the Provincial Governments. The formation of the Committee on Repatriation and Employment was considered necessary to prevent overlapping of the various departments, organizations and committees. It consists of five or six members of the Government Departments interested in the work. An inter-department committee has also been formed and has been hard at work for some weeks. In consultation with this committee is a committee of three members from the Great War Veterans Association, as well as various women's organizations and all of the municipalities.

In closing, the speaker said, "this problem will never be solved by any government alone. It is up to the people themselves. The problem is a national and personal one. The question should not be, what is the Government doing, but what am I to do? Our people have not shirked responsibility in war time and will not shirk it, or fall down in any way, now."

Government will Assist Builders Financially

IN a recently-issued circular of the Ontario Government, the provincial scheme for assistance to prospective builders, as worked out by Mr. J. A. Ellis, director of the Ontario Bureau of Municipal Affairs, is concisely outlined, as in the following paragraphs. The plan appears to be very practical, and should be helpful in relieving the situation:

"The Dominion Government has agreed to make a loan to the Ontario Government for housing purposes. The province will, in turn, loan to municipalities upon the following terms:

"Municipalities and Companies incorporated under the Housing Accommodation Act (R.S.O., Chap. 220), may acquire lands and construct houses for returned soldiers, and also for working men and women and those of small means. The act mentioned will be amended to include all municipalities.

"The type of house to be constructed shall not exceed \$2,500 in cost for the construction of each house. The maximum cost of each house, together with the cost of the land and interest during construction, is not to exceed \$3,000.

"The building scheme of each municipality, including the laying out of the land and the plotting of the buildings thereon, the plans of the houses, the form of construction, and the location of the land to be developed, shall be approved by the Director of the Bureau of Municipal Affairs, or such other person or body as may be designated for that purpose.

"The loan will be for a period not exceeding twenty years at 5 per cent.

"Municipalities are to make loans to individuals, firms incorporated as before mentioned, and to persons who own their own land and desire to erect houses thereon for their own occupation, and to farmers for the erection of houses for their employes.

"If a municipality itself acquires land and constructs houses it will be loaned the full amount required therefor.

"The loan to be made to a Housing Company shall

not exceed 85 per cent. of the value of the land and buildings.

"A loan may be made to a farmer, and to a person who owns his own land, to erect a house thereon for his own occupation, to the full value of the building. Also to a person for the erection of a house on land owned by the municipality, provided he contributes in cash the value of the lot or 10 per cent. of the whole cost.

"The loan will be made by the province to the municipalities on progress estimates as required.

"It is suggested that all houses be sold on the monthly repayment plan. The period of repayment must not exceed twenty years and the rate of interest 5 per cent.

"The monthly repayment for twenty years to cover interest and repayment of principal will be about \$20 per month for a \$3,000 house. Interest will be charged on arrears.

"The whole or any part of the principal may be repaid at any time during the twenty years.

"Municipalities and Housing Companies must enter into agreements for sale of such houses, and give deeds for same when the payments are completed.

"Such agreements for sale may be cancelled on default for three months, but a person can sell his interest in the property at any time before default.

"A person taking a house must covenant to repair, and to pay taxes and insurance.

"Municipalities are to repay the province monthly at the same rate as the above monthly repayments. These repayments to begin one month after the houses are completed.

"Housing Companies are to repay a municipality in the same way, and to give the municipality a mortgage upon all the land and houses for which the loan was secured.

"Interest to be charged on arrears in both cases.

"Any municipality may come under the provisions of the proposed legislation after it is enacted, upon a bylaw being passed by the Council.

"The Council must then appoint a commission for the purpose of the act, composed of three members, of whom the Mayor shall be one, and the other two nominated by the Council, not members of the Council, and elected for two years, one retiring each year."

Hamilton and Toronto Sewer Pipe Co. Extends

The Hamilton and Toronto Sewer Pipe Company has evidenced its faith in the immediate development of Canada's towns and cities and the prosperity of the building and construction industries, by the erection of an addition to its Hamilton plant, which will give an increased output of over 50 per cent. This company is one of the oldest on the continent engaged in the manufacture of sewer pipe, having been established in 1860:

The total consumption of city water in Regina, in 1918 was approximately 50 million gallons less than in the previous year, the figures being, respectively, 870,699, 473 gallons and 921,695,728 gallons. On a population basis of 35,000 this is equivalent to a reduction of 1,430 gallons per head or 4 gallons per capita per day. During December the consumption was only 61,595,167, as compared with 86,682,747 in the corresponding month in 1917.

The Construction of Concrete Roads

—By William W. Cox*

THE construction of a concrete road appears very simple to the average person who has not made a thorough study and investigation into the essential details entering into the operation from start to finish. Adequate drainage, preparation of subgrade, selection of materials, workmanship and protection, all have an important bearing upon the desired results of obtaining a first-class concrete road.

The all too common practice of placing concrete on a poorly drained grade cannot be condemned too strongly. Simply because of the bearing power or rigidity of concrete many are inclined to think that the presence of water in the subgrade does no particular harm. A concrete road so placed may show up very well for a short time, but sooner or later the action of frost and the result of heavily loaded vehicles will cause the concrete to crack badly and thus, eventually, result in complete failure of the road. It is, therefore, necessary first to provide good drainage so that the water level in the subgrade is at least 2 feet below the concrete. All cracks or breaks, however, are not caused by inadequate drainage. Uneven settlement of the subgrade seems to be the cause of the majority of the cracks which develop within a short time after the road is completed. It has been observed that where concrete roads have been built on new rights of way, where the entire grade was made new, very seldom any longitudinal cracks develop. Likewise, excellent results have been obtained in cases where the subgrade has been graded one year and the concrete placed the next. Also, longitudinal cracks in cuts are at a minimum where proper drainage has been provided. These results are conclusive proof that details of drainage and the detail in construction of the subgrade should not be omitted.

It is well, likewise, that great care be exercised in the preparation of the subgrade so as to eliminate uneven settlement. To do this where narrow fills or turnpikes exist, they should be scarified, plowed and completely leveled and rolled to the full width of the grade before additional grading is done. The earth then should be placed over the full width, in layers not to exceed 1 ft. in thickness, each layer being thoroughly leveled and rolled. Whenever possible, if it does not seriously inconvenience the traveling public, it is recommended that the grading be done far in advance of the placing of concrete. Where light sand is encountered, watering heavily seems to be about the only method of securing satisfactory settlement; but if only spots of sand are found, it is best that the sand be removed and replaced with surrounding soil. In the final preparation of the subgrade prior to the placing of concrete or aggregate, care should be taken to see that it is true to form and to the proper elevations and that all loose earth is sprinkled and rolled. The placing of concrete or aggregate on loose earth or dust cannot be too strongly advised against.

The coarse aggregate should be either clean gravel or crushed stone.

Gravel should be composed of hard, clean, well graded pebbles, ranging in size from $\frac{1}{4}$ to 2 inches. Clay lumps; soft red sandstone or cemented pebbles cause

surface defects, and therefore, should be rejected. Properly graded gravel should be approximately as follows:

Passing a 2-in. screen..	100%
Retained on a 1-in. screen, not less than	25%
Passing a 1-in. screen, not less than.. . . .	25%
Retained on a $\frac{1}{4}$ -in. screen, not less than	95%

If it is found impracticable to obtain such a grading of gravel, and another grading is used, it should be an even grade in respect to keeping the voids constant.

Crushed stone should be of good angular fracture even run in hardness, and when tested by the standard method should show a toughness of at least 8 and a French co-efficient of wear of not less than 10. Some of our limestone deposits, if handled with care, can be used for coarse aggregate. Crushed cobbles or field stone, when properly sorted, can in many localities be used to distinct advantage. Stone which, when crushed, spalls or pulverizes considerably, of course should be sorted out.

In the selection of both crushed stone and gravel, coated or dirty material should be rejected, even though the percentage of clay or silt is comparatively small. The range in size, even run and percentage of voids for crushed stone, should be about the same as for gravel.

Fine aggregate should be practically clean of silt, clay or loam and graded approximately as follows:

Passing $\frac{1}{4}$ -in. screen..	100%
Retained on No. 20 sieve, not more than.. . . .	60%
Retained on No. 20 sieve, not less than	20%
Passing No. 50 sieve, not more than	20%

A coarser sand is recommended when used with crushed stone. Cement should meet the requirements of the standard specifications for Portland cement adopted by the American Society for Testing Materials in 1916.

Water should be free from oil, acid, alkali or vegetable matter and fairly free from clay or silt.

The batch mixer is considered the standard and should be so equipped that the number of revolutions for a given length of time can be easily obtained.

The forms should have a straight surface and should be set to a true grade and so thoroughly staked in place that no movement can take place when concreting and finishing is being done.

The amount of labor used in the laying of the concrete should be such that every detailed operation can be completed at the proper time and so that the whole is a steady progression. The more nearly the proportions of coarse and fine aggregates and the proportions of cement and the consistency of the batches can be made uniform, the more certain that the concrete when seasoned will give an even resistance to wear. The amount of water used in the mix should be just enough to insure that the mixer will completely discharge its batch to the conveyor. Concrete containing the proper amount of water requires considerable shoveling in place. Alternate dry and very wet batches will cause unequal shrinkage in the body of the concrete, and hence a wavy and unsatisfactory surface.

*Deputy State Highway Commissioner of Michigan. Before the Michigan State Good Roads Association.

More depressions are caused in the surface by the use of too much water than in any other way.

The subgrade should be well saturated before placing the concrete so as to avoid losing too much moisture before the finishing is complete.

The finishing of the concrete, after being shoveled in place, should proceed immediately. It should be surface struck by a rigid template a few times over and then allowed to stand a few minutes until the surplus water comes to the top. The use of a roller of the Macdon type has proven a great help in the finishing of the concrete surface. By its use, the excess water and air are brought to the surface, hence denser concrete is the result. Another great advantage in using the roller is that the ridges and depressions made by the template are entirely removed by rolling a few times. It should be operated, however, with care and judgment so as not to roll out the crown or make heavy depressions in the surface next to the forms. Although the split roller is used in bringing the concrete to the same height on both sides of the joint, nevertheless a split float and template should be used also. The rollers which seem to be the most satisfactory are about 15 in. in diameter, 5 ft. long and weigh about 75 lbs.

Cracks and joints are admitted to be the weak points of a well constructed concrete road, hence great care should be used in placing the joint and finishing the concrete adjacent to it. After a joint is placed and the striking of the concrete progresses towards the joint, there is usually an excess of concrete which has to be removed, hence considerable puddling and working of the concrete is necessary in order to have the surface true to cross-section. On the opposite side of the joint or at the beginning of the section, the striking of the concrete does not cause very much puddling, hence the shrinkage is considerably more and the result is a high and low side at the joint. It is, therefore, recommended that striking the concrete should proceed toward the point enough so as to give about the same puddling effect on both sides. The joint should then be finished with a split float and template so as to finish both sides at the same height.

Because of the trouble encountered in finishing the open joint many authorities are now advocating the concealed joint which is placed so that the top of the joint is not more than $\frac{1}{4}$ in. below the surface. When concealed joints are used they should be held in place as near the surface as possible so that the joint filler will be forced out when the concrete seasons and expands.

After rolling is completed, the surface should be floated with a wooden float or belted to a rough finish. Considerable trouble is often encountered when belting is tried, due to the fact that inexperienced men attempt to belt when the surface is too wet, or attempt to belt too fast. It is rather difficult to describe the exact procedure in belting, or just when to belt, but both can be easily learned by perseverance and observation.

During hot weather or when evaporation is rapid, the surface should be protected by canvas until hard enough to permit sprinkling and covering with earth. Different combinations of aggregates, varying conditions of weather, and different brands of cement, as well as sub-soil conditions seem to cause concrete to behave much differently from other combinations. The mixing, placing and finishing of concrete made from crushed stone and sand are considerably different from those operations when gravel and sand are used.

The use of expansion joints is still a debatable question. The distance between joints varies considerably, but experience seems to indicate that a $\frac{1}{2}$ inch joint every 50 ft. is adequate. Concrete which is laid in the fall seems to expand the following summer more than concrete which is laid during hot weather. Thus the concrete road question is a live and debatable subject.

Notwithstanding all the various points in view, I think we are safe in saying that 75 per cent. of failures and unsatisfactory results in concrete roads could be entirely eliminated if the essential details of good practice and construction were thoroughly observed.

A New Combination Machine

The accompanying illustration shows a new type of machine recently placed on the market by the London Concrete Machinery Co., of London, Ont. It is a combination machine, two machines in one—a concrete mixer of either 4 cu. feet or 6 cu. feet capacity and a hoisting drum of 1,500 or 2,000 pounds capacity, built into one machine and both operated with a "Novo" dust proof gasoline engine. The hoisting drum or the concrete mixer can be operated separately if desired. The motor is of extra large size, giving ample power to



Combination Concrete Mixer and Placer

run the mixer, and to hoist material at the same time. This type of machine will be welcomed by many contractors whose work is not large enough to warrant the operation of two separate machines on their work.

The concrete mixer is suitable also for such work as building silos, barn walls and bridges, is especially suitable for laying sidewalks as the hoisting drum can be used to move the mixer by attaching a cable and operating the hoisting drum. This mixer can be moved 500 feet at a time with its own power. Bricklayers and masons use this machine to mix their mortar. One man with this machine can mix more mortar than six men by hand labor and the same machine can be used to hoist all the material, or to operate a derrick.

The company have brought out the combination machine at the request of a large number of prominent contractors, who had work where one outfit of this type would be more suitable. It gives every promise of fulfilling a long felt want.

Laviolette Apartment House Three Rivers, P.Q.

SCARCITY of houses in Three Rivers, last year, has resulted in private interests adopting new building plans. One of the first citizens to study and try out a new policy for the city was Mr. J. H. Giroux, a young, enterprising contractor of Three-Rivers P.Q. He engaged Messrs. Asselin and Denoncourt, Architects, Three Rivers, to prepare the plans of the Laviolette apartment house. It should be remembered that Laviolette is the discoverer of Trois-Rivieres, P.Q., and therefore his name was a most suitable one for the first apartment building in this city.

The building is U shape and contains eleven flats, varying from three to seven room apartments. All are completely equipped and modernly finished: Hot water heating system, electric lights, three element Hughes electric stoves, electrically heated water tanks and a fire place in the living room.

Mr. Giroux succeeded in obtaining assurance that the city council would relieve the future occupants from the ordinary lease holder taxes so that these tenements are rented, lighted, heated and taxes paid. The flats located on each aisle of the building are rented for \$70.00 per month, and the four rooms flat at the centre, \$45.00 per month. The total cost of the building is \$85,000.00.

The main entrance of the building is on Des Casernes street and faces the new post office building on Le Platon. It is a bay entrance through the centre of which is a concrete floor and lateral concrete curbs running all along the floor except in front of the doors to the large flats in the aisles, which have their main entrance on the side. The doors are in hardwood and

hot water heating system. On every one of the three other floors there is a seven-room flat off each aisle, and a four-room flat at the centre. The floors are of birch, one inch wide. The walls are finished in lime and sand on wood lathing with well designed wood trim well varnished. The building is constructed of plastic brick trimmed with cut limestone. The roofing is a Barrett specification felt, pitch and gravel roof. Steel reinforcement has been added to the bay windows, designed for the large flats, which are provided with a balcony, giving a fine view of the River St. Lawrence.

The work was started during May and is now com-



Ground floor plan

pleted. The sub-contractors were: Carpentry, Anselme Dube, Three-Rivers; plastering, Georges McLeod, Three-Rivers; plumbing and heating Germain & Freres, Three-Rivers; painting, Al Dechamps, Three-Rivers; electricity, J. B. Badeaux, Three Rivers, P. Q.; material dealers: cement, H. Nobert and Cyr. Labelle & Cie, Three Rivers; concrete, stone, Kennedy Construction Company, Montreal; cut limestone, Victor Quarry, St. Marc des Carrieres, P. Q.; lumber, Nap. Bourgeois, St. Angele de Laval; glass, J. P. Oshea & Co., Montreal; hardware, E. Cavangh & Co., Montreal; electric fireplaces, Robert Mitchell & Co., Montreal; bricks, National Brick, Montreal; flooring paper, H. W. Johns-Manville & Co., Montreal; heating system designer, Canadian Domestic Engineering Co., Montreal; general contractor and proprietor, J. H. Giroux, Three-Rivers, P. Q.



General View of Laviolette Apartment House

open on vestuary, the whole creating a pleasing impression due to the reserve and good taste shown in the distribution of the ornamentation. The foundations are of reinforced concrete, mixture 1-2½-5 reinforced with one-inch round bars. The cellar is divided in three leased apartments, of which one is designed for the house porter plus private divided cellars for the flat occupants, and a room for the forced

The Toronto Branch of the Master Painters' Association held its twentieth annual meeting recently in the Oddfellows' Temple on College St., when the following officers were elected for the ensuing year: Major Geo. Alexander, president; J. O. Dougall, first vice-president; Wm. Paris, second vice-president; Stewart N. Hughes, secretary-treasurer; F. H. McCausland and Jas. Kitchener, Auditors; W. Paris, musical director: executive board—A. E. Phillips, W. W. Bamlett, R. Dale, W. Hulme, W. H. Hielt; Morley Watson, T. W. Arlidge, C. M. Hinchcliffe and R. Wood. Mr. Jas. Taylor, who is believed to be the oldest painter in the city, was made a life member of the association. Mr. Stewart N. Hughes, who was re-elected secretary, has held that office during twenty years. He reported that 1918 was one of the best years in the history of the branch.

Tar Macadam vs. Tarred Slag

By W. Jenkinson*

THAT county surveyors are likley to substitute bituminous roads in place of the ordinary macadam roads, particularly where the traffic is heavy, is no surprise. The tendency to do this has been apparent to us all. The reason for this we know, and need not go into. We can take it as an absolute certainty that whenever circumstances permit our county roads are to be composed of bituminous material; the demand for ordinary macadam is to be on the decrease, and the wise quarry master will prepare in advance for this.

With this tendency alone we need not be gravely concerned, if the decrease in the demand for macadam meant a proportionate increase in the demand for tarred granite and limestone, but the reason for the praise being meted out to tarred slag in preference to tarred stone requires consideration. County surveyors have no bias in favor of slag. If say, tarred granite gave better and more economical results than tarred slag, they would quite readily say so, and prefer the former. But that many surveyors have proved through experiment that slag is more satisfactory than granite for tarred roads requires some explanation. That a large number of surveyors, on the other hand, swear by tarred granite does not prove that those in favor of slag are either mistaken in their opinion or biased against granite. What it seems to prove is that, while some surveyors have been fortunate in their choice of tarred macadam, others have been the reverse. Of course, the same might be said of slag, but I do not think it would be correct. All slags are pretty much alike, but there are great differences in granites; and the granite which makes the best macadam in many cases makes the most unsatisfactory tarred macadam. And there have also been great differences in the making of the tarred macadam at different quarries.

Qualities of Granite

Granite (I use the word in its wider sense—commercial granite) may be divided into two sections—course grained and fine grained. The former makes the most satisfactory tarred macadam. Pure granite makes good tarred macadam. On the other hand, very close grained hard granite does not lend itself to tarring. For instance, basalt, while excellent for macadam, is not suitable for tarred macadam.

Pure granite (geologically pure) and sienite make the most satisfactory tarred macadam; while on the other hand pure granite does not make the most satisfactory ordinary macadam. The reason is this. In general, granite—that is pure granite—has a lower crushing strain than basalt, Plutonic rock of granite pophyry. Pure granite and sienite are more loosely grained, their component parts have not fused together to the same intensity as the other stones. The consequence is that the heat used in drying the stone can penetrate further into them, and the tar also can penetrate further into them, and, the grain being rougher, will stay there under the movement of the road through traffic.

On the other hand, the other class of stone is affected in treatment vice versa. Being hard and compact, the heat and the tar in particular do not pene-

trate, and the binder simply forms a thin coating which very soon wears off, and explains the cause in cases where tarred macadam which on being lifted, has been found destitute of tar.

I do not say that pure granites and sienite only are suitable for this class of material, of course. I have simply illustrated extreme cases as a guide to those interested in the subject. It can be taken for granted, however, that the coarser the grain of the stone the better suited it is for making tarred macadam. And it can also be taken for granted that close-grained, extremely hard stone is unsuited for the purpose.

To insure the prosperity of the quarries we have to give satisfaction. Any old stone dipped in tar in any old way as long as it is black, is not tarred macadam, and it is not only damaging the reputation of the manufacturer, but is also doing irreparable damage to the trade in general. That the demand may be greater than the output is no excuse for selling rubbish. In slag we have a competitor of repute, handled by big concerns out to do business, and it will take very careful handling to regain the ground we have already lost through, I sincerely believe, carelessness. Admitting that tarring macadam has been a new branch of the quarry trade, there should be no excuse in the future for committing the errors which have already been made.

Care, great care, is absolutely encessary to make a satisfactory tarred macadam. Given the right quality of stone for the purpose—and some granites are absolutely of no use for the purpose—a bituminous material can be made which will beat any slag on the market. The fact that there are surveyors of repute who swear by tarred macadam is sufficient proof of this. They have used proper tarred macadam. The others have not been so fortunate.

A proper tar binder is essential. One of the proven tar binders on the market is what is required. You cannot improve or equal these by making your own binder. A proper mixer and the proper temperature, careful handling throughout the process—these are the necessities.

The makers of tarred slag are to the front in advertising their wares. It does some good to let people know you have confidence in your product. Perhaps the quarry owners will not give the tarred slag makers all their own way in this respect, but, following their example, and having a good article, will "blow their own trumpets" a bit.

Canadian credits will probably be arranged in the near future for the purchase of commodities in Canada required for the rebuilding of France. It is stated officially that immediately after the signing of the armistice, negotiations were opened by the Minister of Finance with representatives of the French Government in the United States with a view to the establishment of such credits. It is expected that the members of the government who are overseas at the present time and the representatives of the Canadian Trade Mission, who are about to visit Paris, will be able to complete arrangements at an early date.

The Montreal city council has passed a resolution to the effect that the two positions of director of public works and of consulting engineer are unnecessary, and that one of them should be abolished, thereby saving the city \$7,000 per annum.

*From a paper read at a meeting of the Quarry Managers' Association, held at Chester.

Cold Weather Concreting — Simple Frost Protection

IT is often desirable and often necessary to continue concrete construction during winter weather. If concrete is allowed to freeze before it is well set it is likely to be injured, but if it can be protected from frost and maintained under favorable conditions until after it has been placed 48 hours subsequent freezing and thawing is not likely to injure it.

Large masses of concrete below the surface of the ground or under water are not likely to be much injured by frost if placed under proper conditions, in the opinion of "Contracting." Concrete in small masses and in exposed situations needs much more protection. In very cold weather the aggregate water used for mixing any concrete should be maintained at a temperature above freezing until after it leaves the mixing machine.

It is estimated that the extra cost of placing and protecting concrete buildings during cold winter weather varies from 6 to 100 per cent. of the ordinary cost of concreting in mild weather. Often the owners of a building are willing to pay the extra cost to secure uninterrupted prosecution of construction during the winter.

Warming Materials.

In cold weather the sand and aggregate should be warmed before mixing. This can be accomplished by storing them in warm rooms, by running steam coils through the masses, and, for small amounts, by heating them over horizontal hot-air flues or stoves in which wood or coke fires are maintained. Stove pipes, drain pipes, and various improvised appliances will serve well enough for the flues or stoves used for heating small quantities of sand and broken stone.

Mixing water is easily heated by live or exhaust steam in closed coils or discharged directly into the tanks. Live steam at 25-lb. pressure is amply sufficient and may often be efficaciously made in boilers condemned for high pressure service.

The use of salt in the mixing water retards the freezing of the concrete and may also retard the setting of the concrete. A large amount of salt is injurious to the concrete and it is maintained by some authorities that any salt is objectionable to reinforced concrete.

Protection of Concrete in Place.

Mass concrete in foundation pits often requires no more protection than to be covered on top with hay, straw, manure, or tarpaulins. If it is below water level it may be sufficiently safeguarded by allowing the water to flow in and cover it to a reasonable depth.

Concrete above the surface of the ground if in very large masses may also require protection only on top, but in very cold weather it may need to be protected on the sides of the forms as well. This is accomplished by either inclosing the entire space containing the concrete and warming the air, or by jacketing the forms and filling them with insulating material or warmed air.

In buildings it is customary to inclose all of the sides of a complete story with large tarpaulins with their edges laced together or tied to the structure and to maintain inside the tarpaulins a sufficient number of open coal or coke fires to keep the temperature well above freezing.

To protect the topmost floor of a building under

construction small holes from 10 to 20 feet apart are frequently left temporarily in it to allow the warm air from the heaters to ascend and protect the upper surface of the floor. This air is contained by canvas lifted on wooden strips a few inches above the floor surface. When a wet concrete surface is protected by hay, straw, or manure it should first be covered with building paper to keep it clean.

Safeguarding Contractors' Equipment

The California Safety News, issued by the Industrial Accident Commission of the State of California, states that out of 212 permanent and serious accidents due to unguarded machinery that occurred in California during 1914-15-16, seventeen were fatal, costing \$40,800, while the remainder cost \$214,500.

It is noted that a large proportion of accidents were due to power saws which are responsible for injuries to one million persons in the United States during the last ten years. There is no excuse for omitting to equip power with the safety devices specified in the Wood Working Safety orders issued by the Industrial Accident Commission. These require that a circular saw be provided with a hooded guard and with a splitter or spreader or dogs located in the rear of the saw.

Many accidents are also caused by set screws projecting from rapidly-revolving shafts and likely to catch the clothing of the workman. Many accidents occur from the use of mushroomed tools, portions of which are likely to break and fly into the workmen's eyes. In many occupations goggles should be worn to protect the eyes from flying objects as well as from intense light and heat or spatters of molten metals. It is so injurious to remove foreign substances from the eyes by means of a pocket handkerchief, the finger, or any other objects likely to be infected, that some companies immediately dismiss the employee who tries to act as first-aid in such cases.

Empty gasoline tanks are especially dangerous because the small amount of gasoline remaining in them is apt to vaporize and form an explosive mixture.

Many engines have cavities or enclosed spaces likely to become filled with gasoline vapors that will explode if repairs near them are being made by torch light. To prevent this all such cavities should be blown out by compressed air or steam. Loose clothing should not be worn around machinery. Cleaning should never be attempted while the machine is in motion. Heavy machinery should never be moved without abundant help or proper hoisting apparatus. —Contracting.

Toronto's fire loss for the past year shows an increase of \$192,268 over 1917. The figures for 1918 are \$1,357,233, and for 1917, \$1,164,965. The total number of calls answered by the department was 2,669. The loss by months was: January, \$88,637; February, \$168,565; March, \$106,296; April, \$601,821; May, \$15,741; June, \$13,319; July, \$106,810; August, \$13,674; September, \$39,222; October, \$35,285; November, \$123,131; December, \$44,732. The principal fires last year were at the Harris Abattoir, British Forgings, Limited, Cluff Munition Company, Liggett's drug store, Toronto Laundry Machine Company and the Galena Oil Company. April was the high month with a damage of \$601,821.

Victoria's New City Engineer

Mr. F. M. Preston was appointed city engineer and water commissioner of Victoria, B. C., in December last, succeeding Mr. C. H. Rust, who recently resigned to return to Toronto. Mr. Preston was born at Penzance, England, in 1881, and came to Canada in 1911. For two years he was assistant engineer for sewers, New Westminster. From 1913 to 1915 he was engaged in sewer design and construction for the city of Victoria. Next he was appointed engineer in charge of



Mr. F. M. Preston

that city's sewers and bridges. He was assistant city engineer of Victoria from 1917 to 1918, and acting city engineer from September until December, 1918, when he was given full charge. Mr. Preston is an associate member of the Institute of Civil Engineers, London, England, and a Fellow of the Geological Society, England. He was educated at Rugby and at the Armstrong Engineering College, Newcastle-on-Tyne.

Engineers to Report on Montreal's Waterworks System

AT the request of the Administrative Commissioners of Montreal, the council have voted \$25,000.00 for the purpose of employing engineers to report on the aqueduct and the general waterworks system. The aqueduct is now lying derelict and its construction has been the subject of great controversy by Montreal engineers, many of whom consider the expenditure was unjustifiable and that the proposed hydro-electric development in connection with the scheme was not economical.

The commissioners point out that the conduit which supplies the city with water is taxed to its full capacity during the summer and that the demands this year will exceed its capacity. The engineers engaged will be asked to consider the question of the provision of sufficient water through the present conduit for a period of two more years, while the waterworks canal is completed and brought into operation. They will also be asked to consider the best method of utilizing the canal already partially constructed, with a view to supplementing the domestic water supply of the city, and conserving as far as may be economic the possible

water power capacity of the canal in addition. It is further asked that the engineers should study a general scheme of water distribution through the city in conjunction with sufficient reservoir capacity which the city has not at present.

The commissioners state that no complete study has yet been made of the present situation; that the water situation is likely to become acute and that as the question of the aqueduct has caused a great deal of discussion and a diversity of opinion among many engineers, it is advisable to obtain disinterested reports from engineers who have not been associated with the discussion. The names of R. S. and W. S. Lea, Consulting engineers, of Montreal, have been mentioned in connection with the proposed investigation.

At a recent meeting in the Labor Temple, Toronto, the Bricklayers' & Masons' Union elected the following officers: President, T. J. Williams (re-elected); Geo. Reynolds, vice-president; W. Owens, secretary and business agent (re-elected); Elijah Jackson, treasurer (re-elected); T. Broadbelt, tyler; W. Forest, deputy. The delegates to the trades council elected were: W. Lovatt, Geo. Reynolds, Jas. Winning, W. Owens and W. Forest. Messrs. Abnett, Owens, Lovatt, Winning and Reynolds were appointed delegates to the Building Trades Council. It was announced that an agreement was in course of preparation for presentation to the Builders' Exchange. The meeting passed a resolution favoring the proposed housing scheme of the Dominion government.

A trade conference is proposed to be held at Calgary early in 1919 which presidents and secretaries of all boards of trade and community organizations in the four western provinces will be invited to attend. Co-ordination of effort will be the aim set before the conference, the general scheme of which is now being worked out by the Winnipeg, Calgary and Vancouver boards of trade.

Mainly Constructional

East and West—From Coast to Coast

Hamilton ratepayers have voted to raise \$117,000 for storm sewers and \$50,000 for market shelters.

The total of the building permits issued in Galt, Ont., during 1918 is \$171,780, as compared with \$186,430 in 1917.

The Prince Rupert Drydock & Engineering Co., Ltd., has been incorporated with a capital of \$500,000, with headquarters at Prince Rupert, B.C.

The following by-laws have been carried in Sarnia, Ont.: \$55,900 for waterworks intake; \$15,000 for water mains; \$9,000 for incinerator; \$11,000 for pavements.

Building permits have been issued in Winnipeg during the past year for 1,477 new buildings, as against 1,237 in 1917. The value of the buildings erected this year is a little over two million dollars.

The Creterock, the first of the 1,000-ton reinforced concrete vessels in course of construction for the Admiralty by the Gloucester Ferro-Concrete Shipbuilding Co., was launched at Gloucester recently.

The fire losses during the past year in Ottawa, accord-

ing to Fire Chief Graham's report, amounted to \$250,000 for 482 alarms. This is the second lowest loss in several years, and is less than half of 1917, which was \$507,113.

The building permits issued in Welland, Ont., during 1918 reach a total value of \$440,524, as compared with \$241,334 in 1917. The figures for December are \$13,220. In the corresponding month in 1917 the total was only \$1,000.

By-laws have been passed in London, Ont., to grant \$100,000 toward the erection of a new quarter of a million dollar medical school in connection with the Western University and to spend \$50,000 on an industrial area in the east end.

Repair work is being carried out on the bridge across the Bulkley River at Smithers, B.C., to fortify the structure against the onslaught of the ice at the break-up. Investigation has shown that some of the piles were broken last spring.

John W. Gates, Limited, has been incorporated with a capital of \$49,000, head office at Montreal. Among the objects of the company as set forth in its charter, is "to do all kinds of power plant brickwork, boiler covering and insulating work."

At a largely-attended public meeting recently held in Whitby, Ont., a resolution was passed urging that the Ontario Government proceed without delay with the completion of the section of the provincial highway between Toronto and Oshawa.

Vancouver's building permits for 1918 reach a total of 829, at a value of \$1,440,384, a big increase over the 1917 total, which was 561, valued at \$768,255. In December 51 permits were issued, value \$81,658, compared with 36, valued at \$56,295, in the same month in 1917.

The new factory of Penman's, Limited, in Paris, Ont., on the north side of King St. bridge, is expected to be completed by about the first of April. It is to be of red brick, three storeys high, 80 x 180 ft. in plan, costing approximately \$80,000. Work is well under way by Hyatt Bros.

The total of the permits issued in Kitchener, Ont., during 1918, was 153, valued at \$226,062. Of these, 21 were for residences, at an estimated cost of \$49,200; 17 were for business buildings, valued at \$143,500; 29 permits, \$19,412, for repairs and alterations; 86 garages, value \$13,950.

Mr. John G. Morgan, of Moose Jaw, Sask., has been appointed the local representative of the Twentieth Century House Co., Ltd. This company manufacture houses of various sizes and models complete at their mill. They are then shipped to the purchaser ready for erection. In this way, waste of lumber is eliminated.

The Brantford Realty Company is preparing a scheme for the erection of 100 moderate-cost homes in Deverwood Park, Brantford, Ont. The exteriors of these houses will be of brick and stucco, and they will mostly be of the one storey-and-a-half and bungalow types. They will be of five, six and seven rooms. All modern conveniences will be provided.

The Mond Nickel Company is making a bond issue of £1,520,000 in London, England, and it is stated in the firm's prospectus that this capital is required for the extension of its works, which is made necessary by the development of business. The company's mines are in the Sudbury district, its smelting works at Coniston, Ont., and its refinery at Swasea, Wales.

Rumours are afloat that the government does not intend to go ahead with the St. Andrew's military hospital scheme, for which tenders were called December 12. The buildings which have been erected on Rosedale Heights, above the St. Andrew's site, which were originally intended for demobiliza-

tion purposes, will now, it is said, be taken over for hospital accommodation.

County Superintendent Talbot is preparing a report for presentation to the Middlesex county council, showing the necessity of an energetic construction programme in order that the county may keep in line with the government's good roads' activities. He recommends the construction of numerous bridges and also the laying of sections of concrete pavement on a number of principal roads which will act as feeders to the new trans-provincial highway.

Plans are being prepared by City Engineer H. A. Brazier, of London, Ont., for an interceptor at King and Thames streets, which is to take care of the sewage from the new Penman factory being erected on Thames St. Pumps are to be installed at this point to raise the sewage to the level of the present King St. sewer, through which it will be conveyed to the sewage farm at the cove. The capacity will be sufficient to take care of 900 gallons a minute.

During 1918 building permits to an estimated value of \$2,892,582 were issued in Halifax. These figures, however, do not include military, railway or other government works, and it is roughly estimated that the total value of the construction work undertaken reaches a total of \$7,000,000 or \$8,000,000. During the previous six years the building permit issues have been as follows: 1912, \$589,175; 1913, \$835,856; 1914, \$879,320; 1915, \$1,063,985; 1916, \$1,226,529; 1917, \$894,377.

The Standard Shipbuilding Company propose the construction of a drydock at their yards on the Fraser River. This dock will accommodate vessels up to 610 ft.; the width on the floor will be 62 ft.; depth of water over sill at low water, 20 ft. The company has purchased 65 acres, with a water frontage of 3,600 feet, and is now driving piles and preparing ways to lay keels for eight 3,500-ton composite steamships contracted for by Belgian and Portuguese interests.

Officials of the health department in the city of Regina, Sask., are discussing the necessity of installing modern plumbing in all houses not so equipped, and will probably submit a scheme to the newly-elected members at an early date with a recommendation that measures along this line be taken. It is estimated there are between 700 and 800 houses without water and sewage services and that a total expenditure of \$225,000 will be required to connect them with the city mains.

A housing conference was recently held in Winnipeg for the purpose of discussing the Dominion Government's housing scheme. At this meeting Trades and Labor delegates and representatives of the Manufacturers' Association were present, and a number of women were also in attendance. All were in thorough accord as to the advisability of taking advantage of the government's plan, but it was decided to make a complete survey of conditions in the city, before taking any further steps.

The building permits issued in the city of Toronto during 1918 reach a total of \$8,535,331. The class of building on which the largest expenditure was made was brick dwellings, of which there were 792 erected at an estimated cost of \$2,115,775. Sixty-two frame dwellings were built at a cost of \$52,210, and 127 brick front and roughcast dwellings at \$188,600. There were 77 stores built at an estimated expenditure of \$353,051. Seventeen warehouses were erected, costing \$564,300; 42 factories at \$802,650; and alterations to these two types of building respectively cost \$127,935 and \$912,570. Four new schools were built at an expenditure of \$240,000, and alterations were made in ten schools costing \$54,860. Four new churches cost \$38,175, and alterations to churches cost \$40,360.

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A Sound Basis for Reconstruction

THE Governments, Federal and Provincial, and many of our municipalities, have promised vigorous construction programmes for the season of 1919, and the public and the employers and employees of the building and construction industries are equally anxious that work should be proceeded with on as extensive a scale as is compatible with efficient and economic administration. Therefore, in the near future, there should be, and it is probable there will be, initiated many large undertakings of an industrial and municipal nature and many housing schemes, all of which will cause considerable growth and development of the towns and cities of Canada.

This, on the surface, would appear to be an entirely beneficial result, but—let us stop and consider the past. We have seen growth and development, surely—unparalleled. Towns have appeared over night and cities have developed as at the wave of a wand. To-day a flag-stop on the prairie, to-morrow a full-fledged "city." We have seen all this and we have said that Canada was growing—but we have seen more. We have seen thriving communities fade away at the first breath of adversity, we have seen a mushroom growth of shack-

towns and slums, which are a curse and an encumbrance to any municipality, and we have seen fire in a night wipe out whole towns, even whole districts. These conditions have probably more than counterbalanced the rapidity of our development, and we are to-day certainly no better off than if our growth had been gradual, steady and conservative.

Therefore let us consider the future in the light of the past, and let us build for permanence. Let us make every possible provision against fire, and let us plan and regulate the growth of our towns and cities that they will be habitable and convenient, and, to some degree at least, beautiful. We had better give workmen employment mowing the prairie or sifting the sands of Lake Ontario's shores, than erecting buildings that will be tinder for starting conflagrations, and developing communities that will be breeding grounds for disease and Bolshevism. The fire fiend, the short-sighted and grafting politician, the real estate manipulator, and the jerry-builder, have been Canada's worst economic foes—let us fight them to a finish in 1919.

Technical Education for the Apprentice

THE boy is dependent on his parents or guardians for his start in life and this responsibility should not be lightly assumed. Lack of thought and interest on the part of the parent is responsible for lack of interest and the consequent lack of advancement in his work on the part of the boy.

Comparing many of our young mechanics to-day with the old-time journeyman, we have got to admit that the men turned out now, as a class, are not as competent as were those in the time of our fathers. How many carpenters, for instance, among the younger men, can properly frame a roof on the ground, can lay out and construct a well designed stair, or get out a window and window frame from material taken from the lumber pile? The last may look very simple, but try it and see how much time and material is wasted in the effort.

This apparent lack of efficiency may be accounted for by the present apprentice system that does not demand a certain amount of technical education and training as a part of the young man's apprenticeship. Many of the trades require a fairly comprehensive technical education to qualify a man as a first class mechanic and there is no trade in which technical education will not be of great and lasting benefit.

The inclinations of the boy will, more often than not, determine his future vocation, but he should not be started at his trade and then left to work out his own salvation. In the majority of cases those responsible for the young man's welfare are totally ignorant of what will be necessary to fit him to fully qualify as an expert in his chosen vocation.

In our larger cities, provision has been made for night classes in the technical schools. This is all right as far as it goes, but the average young chap does not feel like spending his evenings in what, to him, seems more or less useless work. The study of certain branches of mathematics, for instance, may appear to be utterly useless to the boy, unless an interesting application showing the value of this science in his particular work is demonstrated in a practical way. Geometry and trigonometry are very often most confusing subjects, but if it can be shown not only how valuable but how essential the solution of angles,

development of surfaces, projection, etc., are to young mechanics, an interest is aroused which can be maintained until the subject is thoroughly mastered.

It should be the endeavor of every trade to turn out each year young mechanics who are thoroughly competent. The fact that a young man has spent a certain number of years at his trade doesn't always mean competence. Every mechanic should be able, not only to read drawings intelligently, but, if necessary, make his own drawings. This may appear to be asking too much, but it is possible, and certainly no effort should be spared in an endeavor to secure this result.

The boy starting his apprenticeship has not had sufficient experience in life to fully appreciate the value of education; consequently some one must do his thinking for him. This education must be secured before the lad has got away from the habit of studying and before he assumes obligations that demand all of his time. The apprenticeship course should be laid out so as to include educational classes in technical work. Attendance at these classes should be made compulsory in order to insure regular attendance. To be of the most value the work must be practical. Theoretical work must not be neglected, but a certain amount of practical work should be worked in with it to demonstrate to the pupil a practical application.

All instructors should, of necessity, be practical men, men who have worked at the trade and are thoroughly familiar with the difficulties to be contended against. It is only the practical mechanic that can satisfactorily instruct and hold the confidence of the young apprentice.

Employers, manufacturers and the various trades and labor councils, as well as individual mechanics, should unite in a concerted effort to secure for Canada a system of technical education in keeping with other development policies at present being formulated at Ottawa.

Premier Hearst Promises Ample Work to Relieve Unemployment

SIR WILLIAM HEARST, Premier of Ontario, in an address before the Engineers' Club, Toronto, last week, pointed out that the construction work which the government proposed to undertake would be sufficient to provide employment for all who wanted it during the transition to a peace basis. He referred to the great work done by the engineers at the front, and said that those at home could also do good work towards promoting the prosperity of the country. To this end he appealed for their assistance, urging that the war record of the provincial government was sufficient proof of its ability and determination to face the future.

The Premier emphasized the importance of the good roads movement as a means of providing employment and also of building up agriculture and trade. This movement had had to be abandoned by the Government during the war, but now it was the intention to go ahead with redoubled energy. Housing, he declared, was another very essential undertaking, to relieve present congestion, which would at the same time take care of thousands of workmen. He believed it was a great opportunity for the engineer, and that if taken up at once in a conservative manner by the municipalities, would bridge the next three or four months with plenty of employment for all.

Building Trades League Urge Commencement of Government Program

AT a recent meeting in the Labor Temple, Toronto, J. Dogget, president of the Building Trades League, stated that there were 2,000 men, members of the nineteen unions connected with the trade, out of employment. He said he had heard a great deal about reconstruction work, and that politicians had made innumerable promises of providing work for returned soldiers and munition workers, but nothing of a practical nature had been done, and it was time for the unions to wake up and demand the governments and the city to get busy and place some orders for needed works. He also declared that the city should start building at least 500 homes for the workers, so that the housing situation might be relieved and rents reduced. The meeting decided to send deputations to Queen's Park and to the City Hall to interview the Premier and the City Council for the purpose of calling their attention to the seriousness of the outlook and to urge that the construction of works which had been delayed by the war, be proceeded with immediately.

Building Permits for the Year

As indicated by the permits issued in the thirty-five principal cities of the Dominion, the value of building work undertaken in 1918 exceeds that undertaken in 1917 by something over \$1,500,000. Below is a list showing the comparative figures for the twelve months of each year:

Estimated Value of Building Permits Issued in the thirty-five principal cities of Canada

January	\$1,562,637	\$1,401,932
February	901,933	1,682,495
March	2,133,781	2,461,162
April	3,005,785	3,231,959
May	4,838,953	3,833,064
June	3,667,399	4,038,511
July	5,863,834	4,590,461
August	5,018,092	3,233,922
September	2,690,821	2,855,123
October	2,850,428	3,627,102
November	2,387,045	2,149,223
December	1,640,727	874,689
Total	\$36,561,435	\$33,979,643

Thawing Frozen Ground

Frozen gravel can be thawed quicker and faster with hot water than with steam, according to a paper recently presented to the Canadian Mining Institute. In the Yukon district the frozen gold bearing gravel contains 46 per cent. ice which, when thawed from bed rock up, produces cavities undermining the strata and causing it to settle and break. A hollow steel rock drill with cross type bit is welded to a 3/4-in. point and driven to bed rock where hot water is discharged through five 3/32-in. holes. It is revolved by hand and driven by sledges by two men and is estimated to effect a saving of 33 1/3 per cent. time and 50 per cent. fuel over the steam heating method. It is said that after the drill has penetrated part way through a boulder the expansion causes it to split and allows the drill to drop through to the bottom.—Contracting.

Building Prospects in B. C.

— By T. P. S. Twizell, A. R. I. B. A., Vancouver, B. C. —

NOW that the war is over and peace in sight, is there going to be a revival of the building industries in British Columbia? This question looms large in the minds of men of this province who are in one way or another connected with the building trades.

For two years previous to the war there had been depression in this industry, and opinions were expressed that conditions had reached their worst and that any change must be for the better.

A wave of pessimism followed the outbreak of hostilities and masters and men looked forward to an indefinite period of further waiting. However, it is an ill wind that blows nobody good, and this province, with others, benefitted by the demand by all the allies for munitions and ships. The growing and urgent need for boats paved the way and made possible in Western Canada a shipbuilding industry which has become of considerable size and importance.

The demand for labor in this market could not be met by those trained in this particular description of work and recourse was had to men who were trained in branches of labor of a somewhat similar kind; with the result that architects' assistants have found work in the draughting office, and mechanics in all classes of labor previously employed in erecting buildings were engaged in the yards of the several shipbuilding companies. The demand for minerals gave an impetus to mining, and some of the important companies, such as Granby Consolidated Mining Co., undertook schemes of considerable size, for housing their work people and also the erection of many permanent buildings. Manufactured products of all kinds were sought after, and this brought about a demand for a limited number of small factory buildings which in the main have been built of lumber. Even in the aggregate, however, this work has not been large, and although it has kept certain firms actively busy for longer or shorter periods, yet it has not affected the majority of the building contractors or material men of the province. Meanwhile the cost of living has risen very considerably. Prices of materials of all kinds are abnormally high, and the cost of lumber has gone up in proportion, so that at the present time the rates of wages paid in the shipbuilding yards are as follows:—Unskilled labor, \$4.13; carpenters, \$6.00; ironworkers, \$8.00; painters, \$5.50.

Shipbuilding may not be a permanent industry here, but at any rate there is no sign of its immediate cessation, and as long as high wages prevail in the yards, high wages are likely to be asked for in the building trades.

Two questions now arise: (1) What demand is there for new buildings? (2) To what extent will the present and prospective costs of labor and materials modify or check the demand for new buildings? Of these two questions the first is perhaps the easier to answer.

There is no indication of anything like a building boom, but there are indications of a limited revival, more especially in shipbuilding centres where there has been a steady demand for houses. Apartment blocks also are well filled, while the rents of all classes of property have gone up in sympathy. As a result of this situation, efforts have been made in several dis-

tricts to erect dwellings under conditions where the saving on the low price of the land will counterbalance the increased cost of building. This has proved successful in a number of instances, although great caution is being exercised as the additional need for accommodation is considered to be dependent upon whether or not the shipbuilding industry continues to flourish.

Lack of accommodation in apartment blocks has brought about a desire to develop in this direction also, but while in many instances probable costs and returns have been carefully considered, extreme caution is being shown here also, for the reason previously given. In the neighborhood of Vancouver there have been built during recent times several private houses costing from \$8,000 upwards, and there is undoubtedly a desire on the part of other residents to follow this example.

There is no lack of office accommodation and no projects for erecting structures of this class in the immediate future, except in possible isolated instances. On the other hand, there is a definite lack of certain buildings of a public character. Several of the school districts are in need of additional school house accommodation. The city of Vancouver is preparing by-laws for an expenditure of nearly \$500,000 for technical and elementary school buildings, and this will come before the ratepayers for confirmation at the forthcoming municipal election. Another item to be voted upon is a proposal to raise \$750,000 for a new city hall and soldiers' memorial.

In some of the cities and towns there is a class of cheaply constructed buildings which are going out of date. A few years ago owners would have removed such and replaced them with better buildings, but now there is evidence of an intention to merely repair and alter these properties and add new store fronts in the way of improvements. This idea is also being followed in respect to many of the old houses. Why this course of altering and repairing is being pursued, instead of rebuilding, can best be answered by referring to the second question which was put—viz.:

To what extent will the present and prospective costs of labor and material modify or check the demand for new buildings?

The high cost of labor and materials, existing not only at present, but giving promise that such will continue for an indefinite period, is unquestionably deterring owners from undertaking building schemes which would otherwise be started. The promise of continued high costs does not materially change the situation, because while rentals may be high for a time, yet under normal renting conditions a structure which has been erected at an additional capital outlay of 35 to 40 per cent. cannot expect to successfully compete with similar buildings erected during times when prices were lower. In consequence it is becoming the policy of private persons and public and other corporations to reduce their building programme to a minimum with the hope that by delay they may eventually obtain lower prices.

In Vancouver and districts where school accommodation is urgently needed, and where in the ordinary course of things substantial school buildings would be in course of erection; the trustees, with the approval of the ratepayers, have met this want by erecting a number of temporary single room schools, built of wood.

School buildings have been taken as an example, as the need for such can be very urgent and admit of no

delay in providing for the want. Public buildings of other kinds, although required, can often be deferred as being less essential for the carrying on of public business, and there would therefore seem to be little likelihood of such being started at times when schools are being postponed.

On the other hand, there are many people who are not prepared to wait indefinitely for building a private house, and some development is expected in this class of work. With these are manufacturing and other concerns which have prospered in the war period, and are prepared to extend existing, or add new, premises with a view to increasing their business; this class of building will therefore go on in spite of cost.

It may be that certain corporations, such as banks, insurance companies, etc., may act in a patriotic manner and erect permanent premises at present prices, with a view to assisting in the providing of employment for returned soldiers, but only time will prove if this will be so.

It must be recognized that this is still an unsettled period, that although the war is won, yet the future is by no means perfectly clear. There may be a big trade boom and prices go still higher and so continue for several years; but it also is possible that they may become lower, even though not nearly to equal those of pre-war times.

That there is this element of doubt is quite evident and it seems to be the intention of the prospective builders of this province to follow for a little longer the policy of "watchful waiting."

Organization of Association of Canadian Building Industries Proceeding

The work of organizing the Association of Canadian Building and Construction Industries is now being carried out, meetings for this purpose having been held in Toronto, Montreal, and Ottawa. It is proposed to divide Canada into districts, and the work is proceeding along those lines.

Some delay has occurred in receiving the corrected proofs of the stenographic report of the conference at Ottawa, but it is expected that the report will be issued in printed form, comprising about 36 pages, at the end of the present month. One of the first requirements in establishing an association of this character is to secure the requisite financial assistance, so as to be in a position to appoint a permanent secretary, etc. It is proposed to ask those who receive the report to subscribe to the organization fund in amounts from ten dollars upwards.

A list of names and addresses of contractors and supply men is being compiled, but as it is practically impossible to get a complete list, builders and supply men who desire a copy of this report can secure it by sending their names and addresses, and also the nature of their business, to Mr. A. H. Dancy, 1112 C. P. R. Building, Toronto, or to Mr. J. P. Anglin, Anglin's, Limited, 65 Victoria Street, Montreal.

Belgian Reconstruction Needs

The following is a condensed list of materials required for Belgian reconstruction work, as mentioned in a report of the Belgian Section of the Inter-allied Commission:

Probable immediate requirements for building (tons): Copper, sheets, bars and ingots, 39,000; brass,

sheets and tubes, 3,500; machine tools, 60,000; vegetable oils, 3,630; mineral oils, 4,269; hawsers, steel cables, belting, electric power plants for colliery requirements, pig iron, 1,012,050; iron and steel, worked and semi-worked, 825,000.

Transport materials for railroads, locomotives, trucks, etc.; automobile transportation material, trucks, trailers, cars; depot material, turntables, forges, pits, drilling machines, jacks, etc.; working material for reconstruction of destroyed buildings and public works; builders and constructional work, crushers, mixers, hoists, cranes; bridges, locks, etc., pontoons, chain and accessories; dredging material, dredges, tugs, and carriers, lighters; canal equipment, lighters, pumps, compressors, tugs.

Machines for road and construction work, scrapers, graders, rollers, etc., boilers, engines, pumps, steam shovels.

Small tools, shovels, picks, mattocks, etc.

Railway construction materials, rails and accessories, tools, machine tools, motors, signalling apparatus.

Agricultural machinery requirements (tons): Plows, single, 40,000; plows, two or more shares, 20,000; skimmers, scarifiers and cultivators, 20,000; harrows, 75,000; ordinary rollers, 20,000; disc rollers, 10,000; horse hoes, 10,000; potato plows, 10,000; seed drills, 2,000; reapers and binders, 2,000; mowers, 2,000; horse forks, 2,000; horse rakes, 2,000; winnowing machines, 50,000; root cutters, 10,000; chaffers, 15,000; churns, 50,000; carts and vans, 100,000.

The Manitoba Branch of the E. I. C. have appointed a committee of five to initiate a campaign for the widest possible exploitation of Manitoba's possibilities. The members of this committee are: J. G. Sullivan, former chief engineer of the Western Division of the C.P.R.; W. Smaill, engineer on the Greater Winnipeg Aqueduct; J. M. Leamy, provincial engineer; W. P. Brereton, city engineer of Winnipeg, and W. J. Dick.

A deputation representing the Toronto Builders' Exchange, the Provincial Builders' and Supply Association, and various other employers' organizations, recently interviewed Premier Hearst and Hon. I. B. Lucas, Attorney-General, to protest against any changes in the Workmen's Compensation Act, which had been petitioned for by the Building Trades' League. The amendments proposed by the League were mentioned in the December 25 issue of the Contract Record in the report of the dinner-meeting arranged by Mr. Dillon. These amendments, in the opinion of the organizations represented, were quite unjustifiable, and they were opposed to any increase in the proportion of compensation under the Act on the ground that it would act as a penalty on any proposed construction in this period when it is needed. The Premier promised that the matter would receive careful consideration.

The representatives of thirty municipalities on the south shore of the St. Lawrence River have passed a resolution asking the Federal Government to construct a bridge across the St. Lawrence, and to authorize the Montreal Harbor Commissioners to proceed with the work.

John Gunn & Sons, of Winnipeg, have the contract for the erection of three wooden truss bridges in the municipality of Portage la Prairie.

Aqueduct Crossing Under the Red River, for Winnipeg Water Supply

By Mr. J. Armstrong*

FOR the benefit of those readers who may not have read the previous series of articles in the Contract Record of dates Feb. 28, March 7, March 28, April 25, and May 2, 1917, relating to the construction of the Greater Winnipeg Water District Aqueduct, the following brief synopsis is given before taking up the subject matter of this heading:

The Greater Winnipeg Water District is comprised of the cities of Winnipeg and St. Boniface, the town of Transcona and portions of the municipalities of St. Vital, Fort Garry, Assiniboia and East and West Kildonan. The area of this district is some 92 square miles containing approximately 250,000 inhabitants.

The organization for construction purposes consists of an Administration Board, composed of members of the councils of the different municipalities concerned, under the chairmanship of the mayor of the city of Winnipeg.

The active direction of construction is in the hands of two commissioners and the chief engineer, the present personnel being Mr. R. D. Waugh, chairman, Mr. James H. Ashdown, and Mr. W. G. Chace, chief engineer.

The aqueduct just built, to supply this community with water, draws its supply from Shoal Lake, a subdivision of the Lake of the Woods, near the boundary between Manitoba and Ontario. The distance from the Shoal Lake intake to McPhillips street reservoir,

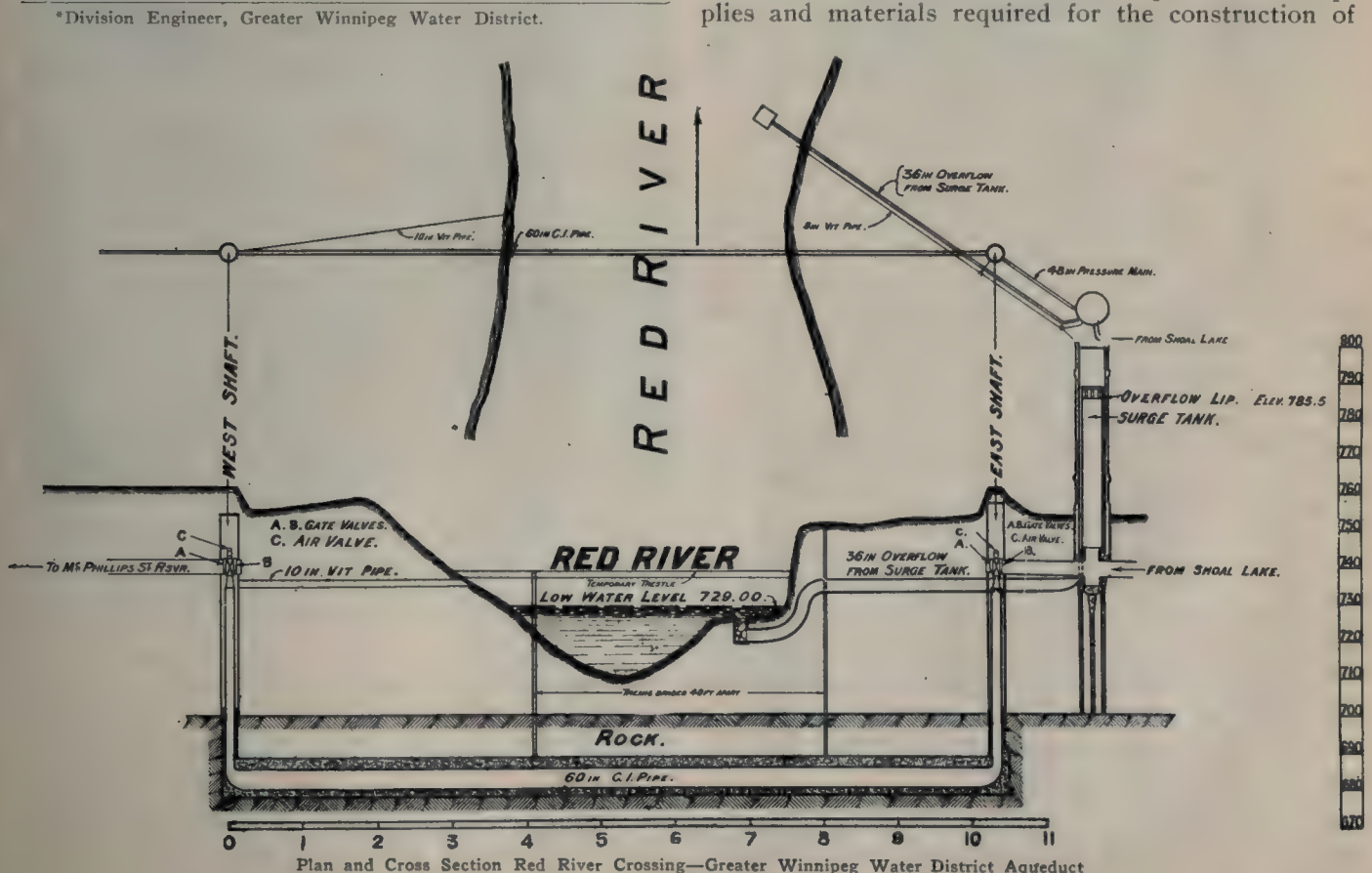
Winnipeg, is approximately 97 miles. The difference in elevation between Shoal Lake and the Winnipeg Reservoir is approximately 295 feet, the intervening country being of such a nature as to allow of this difference in elevation being used to produce a continuous gravity flow between these two points.

From the Shoal Lake intake for 80 miles towards Winnipeg the type of structure used is the horse shoe concrete arch, except for short sections, where the water is syphoned under rivers, when a circular reinforced concrete tube is used. The horse shoe arch varies in size from 10 ft. 9 in. x 9 ft. 0 in. to 6 ft. 5 in. x 5 ft. 4 in., depending upon the gradient, the line of the aqueduct having been located so that in general the top of the arch is about the original ground level and the grade of the line approximating to the general fall of the country.

This 80 miles was designated to carry 85,000,000 gallons per day, and such observations as have been possible since the water was turned into the aqueduct in December, indicate that this amount may be somewhat exceeded.

From the western end of this 80 mile horse shoe section a circular reinforced concrete pipe 8 ft. in diameter and some 4 miles in length is used to deliver the water to Deacon, where it is eventually designed to establish a reservoir with a capacity of 200,000,000 gals.

For the handling of the immense quantities of supplies and materials required for the construction of



this section just described the District built and operated a standard gauge railway.

From Deacon to the Red River, a distance of about $9\frac{1}{2}$ miles, the water is conveyed through a reinforced concrete pipe 5 ft. 6 in. in diameter, and will be under pressure. This pipe, with the aid of a booster pump, will have a capacity of 50,000,000 gals. per 24 hours.

This line was constructed by pre-moulding the pipe in sections 8 ft. in length in a central yard locat-

poured along each side. After being allowed to stand for some time to effect any slight settlement which might occur, the final concrete joint was made and the whole shortly afterwards backfilled. The type of joint used was that contained in the patents of the Canada Lock Joint Pipe Co.

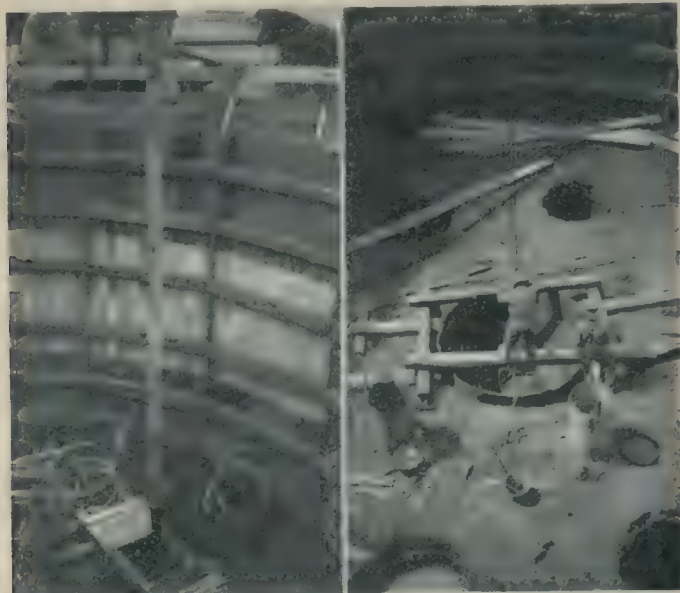
Manholes are provided at intervals of about 1,000 feet, and automatic air valves at points where air might accumulate.

Crossing the Red River

For the purpose of conveying the water from St. Boniface to Winnipeg the pipe line is conveyed under the Red River dropping from the level of the 5 ft. 6 in. concrete pipe 60 feet through a vertical shaft then through a horizontal tunnel 1030 feet in length to the west side of the river, thence through a vertical shaft to the level of the pipe conveying the water to McPhillips Street reservoir.

At the top of each riser are valves for the control of the flow, and at the east riser a surge tank for the purpose of equalizing the flow when valves are being opened or shut.

Both shafts consist of reinforced concrete caissons 16 feet in diameter, sunk through the overlying earth to rock which is met some 53 feet below the surface.



Timbering of Surge Tank excavation

Concreting foundation piers, surge tank

ed at Transcona, and distributing from there along the trench as opened, by the District's Railway.

The trench from Deacon to the Red River averaged 16 ft. in depth and 11 ft. in width, and was excavated by steam shovels operated from platforms straddling the trench, the material thus removed being placed close to one side, the same shovels returning later to use this material to backfill the trench after pipe laying.

The underlying clays encountered in excavating were found to be of such a plastic nature that a natural slope to the walls of the trench was out of the question. Vertical trench walls were therefore specified and held in place by piles driven at 4 foot centres in advance of the excavating shovels, the necessary bracing added as the piles were uncovered by the shovels.

During the season of 1917 two camps were at work, one working from the Deacon end, and the other from a point in St. Boniface. In 1918 a third camp was put in operation through St. Boniface to the Red River. In this latter section the Seine River was crossed by depressing the pipe line to an inverted syphon.

For excavating purposes a row of Wakefield wooden sheet piling was driven along each side of the trench and the river water which fortunately remained low throughout the season was carried over in an open flume. The maximum depth of excavation was 24 feet below water level.

The trench bottom was prepared for the concrete pipe by first laying an 8 in vitrified tile drain along one side, then a bed of gravel 8 in. in thickness carefully consolidated by tamping. The pipe was then laid to line and grade and a continuous concrete cradle



Above—Foundation piers and drain, surge tank
Below—Grillage floor support resting on outer piers

The shafts are then continued down into limestone rock some 25 feet, the connecting tunnel being 10 feet square in section.

The concrete caissons were sunk by constructing them in 8-foot sections. The first section was cast upon the surface of the ground with a steel cutting edge. When the concrete was sufficiently set the forms were removed and excavation commenced inside the caisson, the weight of the caisson carrying it down as the material was removed. As each section disappeared below the ground another section was

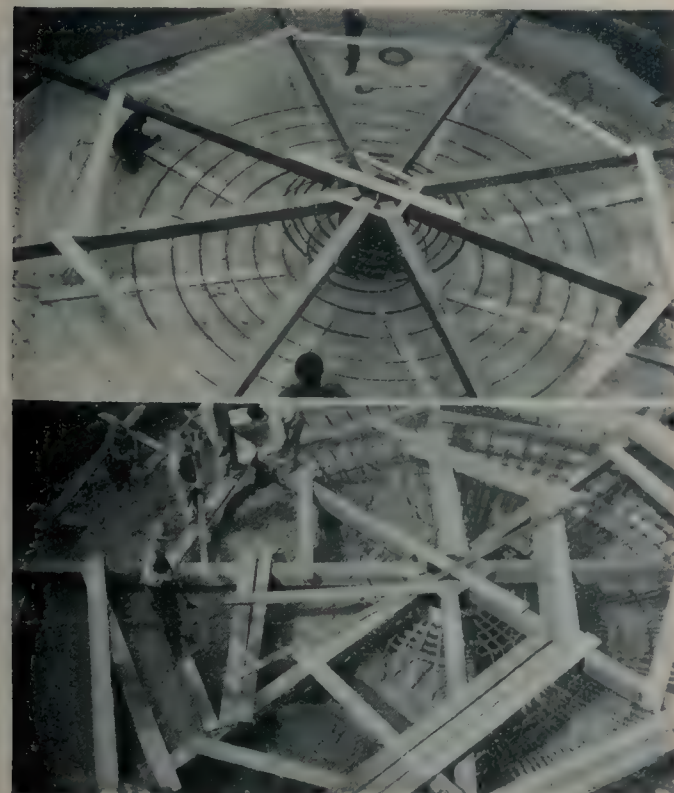
cast on top of it, proceeding in this manner until the cutting edge of the first ring struck the rock.

The walls of the caisson were 24 in. in thickness, and were formed in collapsible circular forms, the same set of forms being used on each successive section.

The material met with was all easily dug by hand with the exception of the last 10 or 12 feet, which developed into a sort of hard pan mixed with boulders. A moderate amount of water was met with and easily taken care of by bailing, until near the rock, when a 2 in. Cameron pump was installed. An occasional tendency for the sinking caissons to stick was easily overcome by pouring water around the outside. A few minutes of this usually sufficed to start it going again.

When first commencing the rock work at the St. Boniface shaft considerable difficulty was encountered owing to the very open, seamy nature of the limestone, and to the presence of many pockets of white clay found throughout the tunnel section. This open seamy rock also allowed a great deal of water to enter the excavation, so it eventually became necessary to install a 4 in. submerged centrifugal pump, driven by electrical power from the surface. However, this fortunately controlled the water effectively, and no need to resort to compressed air was found, and was originally expected.

With the exception of the first 300 feet next the St. Boniface end the rock encountered was fairly good.



Above—Placing reinforcement, surge tank floor
Below—Placing concrete, surge tank floor.

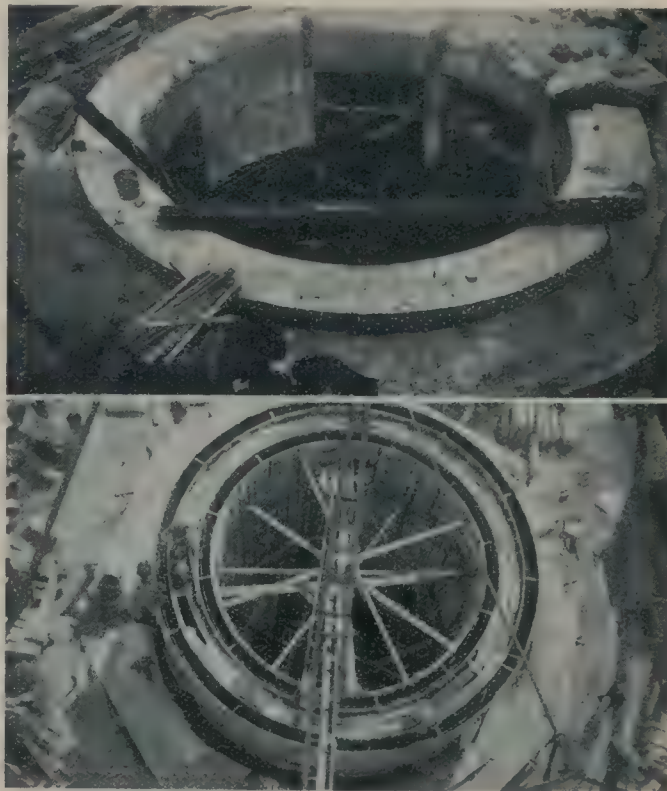
Some 400 feet of the 1,030 was timbered to prevent the falling of the roof in these seamy localities.

At one point 130 feet from the St. Boniface shaft the caving and dropping eventually disclosed a hole entirely through the rock roof and occasioned a flow of mud and water which took a week or ten days to repair. This repair was effected by additional timbering sheeted to hold the mud and sand and divert the

water to the sides of the tunnel when it was led to the pump

The water way through these shafts and tunnel is a 60-inch cast iron pipe, the joints in the risers being flanged and in the tunnel bell and spigot joints, designed to caulk from the inside, the material used in caulking being hemp and lead wool. The joints were caulked by first placing the hemp by hand then $2\frac{1}{2}$ inches of lead wool tightly driven with pneumatic hammers.

The pipes were lowered through the east shaft by



Above—Completed foundation ring, surge tank; also shows outlets
Below—Surge tank walls, photo taken from concrete tower

means of a derrick on to a low, wheeled truck, in waiting at the bottom. This truck ran on rails and was designed of such a height as to run the bell of the pipe it carried on to the spigot of the previously laid one. Two steel cradles were then placed under the pipe with a jack under each end and the weight of the pipe transferred from the truck which was then withdrawn. Wooden cradles were then placed and the pipe lowered on to them and the jacks removed.

Each pipe section was 8 feet in length, averaging in weight 9,300 lbs. By this method as many as 15 pipes have been placed in an 8-hour day.

After laying the tunnel pipe the balance of the section was filled with concrete. In order to insure that all space should be completely filled with concrete a series of 6-inch well holes were drilled from the surface of the ground through the roof of the tunnel, and the concrete poured from above through this tremie. Through the earth or clay overlying the rock the hole was lined with ordinary well casing, but no lining was required through the rock. These holes were spaced at an average of 40 feet, being sunk to a high spot in the roof nearest to such spacing.

The first stage was to pour a concrete floor in the tunnel carefully finished to grade to facilitate the transportation and setting of the cast iron pipe. After plac-

ing the pipe and the joints caulked or partly caulked the tunnel was bulkheaded off in sections of approximately 40 feet and concrete poured down through the tremies until the pipe was covered from 6 inches to 12 inches, which usually brought the concrete surface within 18 inches of the tunnel roof. Men were kept working in the concrete along each side of the pipe as long as possible, usually to within 3 feet of the roof, finally backing out, shoving the concrete back to as great a height as possible to maintain it as they retired.

For the final sealing of the tunnel this last 18 inches was bulkheaded off in sections of approximately 120 feet or three holes, the concrete then poured down the two end holes, leaving the centre hole as an observation station. In every case when the two outer holes were filled the concrete rose in the centre hole to within a few feet of the same level, thus showing a practically hydrostatic action and indicating the thoroughness with which all cavities must have been filled. The concrete head was from 55 to 75 feet,

not coarser than a very coarse sand poured somewhat wetter than the previous mixture, and in the proportions of one cement to three aggregate.

These mixtures were made rich in cement with the object of obtaining a dense concrete found advantageous in resisting the action of alkaline salts so detrimental to concrete in this country.

This concrete filling was continued up the shafts to the level of the rock surface. From the rock sur-



Completed surge tank

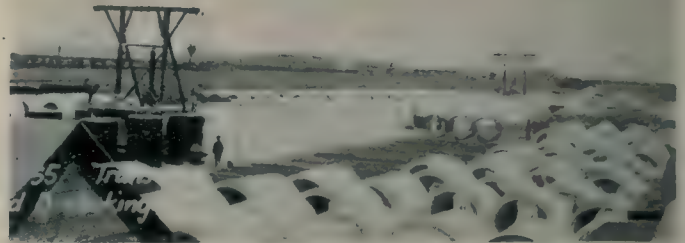
the resultant pressure being clearly evinced by the squirting of concrete grout from cracks in the bulkheads.

The bulkheads mentioned in the first stage were plank as they had to withstand no great pressure, but for the sealing process concrete bulkheads were used and constructed from two to four feet thick upon the first stage concrete when it was sufficiently set. These concrete bulkheads or dams in setting sometimes shrank away from the rock roof slightly and as mentioned above the pressure from the sealing process caused the grout to spurt through these cracks until they became clogged.

The concrete poured through the tremies for the first stage work was made from an aggregate having no larger stones than $\frac{1}{2}$ -in., and was the same as used in the manufacture of the concrete pipe between Deacon and the Red River.

The concrete was poured moderately wet and collected in a specially designed chute at the bottom of the tremie to prevent segregation. The mixture used was one of cement to four of aggregate, and required about 23 gals. of water to the yard.

For the sealing process the aggregate used was



Above—Curing pipe before transporting to trench
Below—General view, one of concrete pipe yards

face to the valve chambers was backfilled outside the pipe sections with gravel.

The surge tank for the regulation of the flow consists of an inner tank 25 feet in diameter with a capacity of 150,000 imperial gallons, with the overflow 47 feet above the inlet, spilling entirely around the



60 in. cast iron pipe used under Red River

tank between two concrete walls 15 inches thick of reinforced concrete and spaced 2 ft. 6 in. apart. The third, or outer wall is of brick and stone spaced 2 ft. 6 in. apart. The third or outer wall is of brick and stone, spaced 2 ft. 9 in., and will enclose the steam coils of the heating plant.

These three walls are carried on a heavily reinforced

ed concrete foundation ring which, in turn, rests upon the floor, which is also heavily reinforced, the whole structure being carried on 9 in. concrete piers 4 ft. 6 in. in diameter, resting on the rock.

The main excavation to the top of the foundation caissons was carried down 51 feet in diameter and 26 feet below the surface the timbering being formed in a sixteen sided figure with the walings mitered and spaced about 5 feet apart. This was found sufficiently stiff to hold without the use of strut bracing and left the whole interior area free for working operations.

The caissons were excavated by placing circular forms, held in place by iron caisson rings as excavation progressed. As the concrete was placed these rings were removed and the planking left in place. The concrete for the caissons, floor and foundation ring was mixed in a $\frac{3}{4}$ yard mixer on the surface and lowered into place in buckets operated by a derrick.

The two inner concrete walls were poured simultaneously, using forms permitting of rings about 7 feet in height, being poured at each operation, these forms being jacked up after each successive pouring. After the concrete reached the ground level a tower was erected at the mixer, 90 feet in height, and the concrete hoisted from the mixer and delivered from this tower through chutes and tremies to its location in the walls.

From the west shaft to the McPhillips Street Reservoir, known as Contact 65, a reinforced concrete pipe 48 inches in diameter was used similar in construction to that used between Deacon and the Red River. The operations of trench excavation, pipe laying, etc., were generally also similar with such modifications as were necessary to meet the conditions of restricted space to work in. Additional problems were also met in dealing with house connections to sewers and water mains, crossing street railway tracks, etc., all of which were overcome with little inconvenience to the public, in fact a surprisingly small number of people seemed aware of the fact that the main trunk of the Greater Winnipeg water supply was being laid through the heart of the city.

The water is discharged into the reservoir by two 36 in. cast iron branches leading from the concrete main, each branch discharge being controlled by a gate valve.

Just preceding the branching a Venturi meter is installed having a 28 in. throat and the necessary automatic recording apparatus.

Before putting into service the line from Deacon to McPhillips Street was filled with water and subjected to a test under 40 lbs. pressure.

The contract specifications allowed a maximum leakage of 9,000 gallons per mile per 24 hours, and the test showed a satisfactory margin better than this.

Mr. Leifur Magnusson's Address on Housing

ON the afternoon of January 10, by arrangement with the Department of Social Service of the University of Toronto, Mr. Leifur Magnusson, of Washington, delivered an address in the Biological Building of the University, on the all-important question of housing. Mr. Magnusson, who is connected with the U. S. Department of Labor, has been engaged in dealing with this problem for the U. S. Government.

The chairman of the meeting, Professor Mavor, in introducing the speaker, made some interesting remarks as to the situation in Canada. One circumstance

that had helped to produce the present conditions was the relatively greater growth in urban than in rural districts, and what marked a great difference between conditions here and in other countries, was the tendency of working men to own their own homes. In Toronto, a survey made some years ago showed that about 50 per cent. of the population were home-owners. This circumstance made it desirable that there be ground around a house, but this was far from economical in centres of population, owing to the greater cost of streets, sewers, etc. This same circumstance was a means of preventing workmen from moving from one town or city to another. There has also been very little inducement for the investor to put his money in houses for rent, particularly in the cheaper class, because of the uncertain demand, the relatively high taxation, and serious depreciation.

Mr. Magnusson, in opening, pointed out that he had been engaged since 1916 in making a survey of housing by employers for the Department of Labor. The war had revealed the housing problem, not as a temporary emergency, but as something chronic. It was a peculiarity that the supply is usually greater than the demand for the most costly class of houses, but in the cheaper class, suitable for the workingman, the reverse is true. To those in touch with the situation the shortage had been apparent even since 1913. A normal expenditure in peace time of one billion dollars shrank to one tenth that amount in 1917. The first official body to take the question up was the Advisory Council of National Defence, and afterwards the housing was delegated to the Department of Labor. In May, 1918, a bill was passed authorizing the president to form a housing bureau, and later the United States Housing Corporation was formed under the Department of Labor. Altogether, by July 8, 1918, there was \$110,000,000 appropriated by the Department of Labor for housing, and an additional \$50,000,000 by the Shipping Board.

Mr. Magnusson said he believed a mistake had been made in not concentrating the administration of this work of providing housing in one body. The United States Housing Corporation, he pointed out, had taken five different ways of relieving the situation: (1) By making investigations to make available housing accommodation which was unoccupied; (2) By connecting by transportation facilities sections where housing was available with those in which there was a shortage; (3) By encouraging private capital; (4) By aiding in the distribution of labor in such a manner as to make use of all available housing; (5) By the construction of houses and apartments. The fifth measure was the principal object of the corporation, but it was only resorted to when the other means had failed.

One of the principal divisions of the corporation was the Home Registration Service. It was its purpose to make available such housing as was available in any community. It had frequently been able to solve the difficulty by the provision of transportation. Transportation companies had been assisted financially, and in certain cases ferry boats had been put in service, and where rates were high the fare was reduced and the corporation paid the balance.

It was only where other means had failed that the corporation bought land and built houses. Dormitories were only employed where speed was the first consideration and the industry with which they were connected of a temporary character.

Daylight vs. Sunlight in Sawtooth Roof Construction*

By W. S. Brown, Assoc. Mem. A. S. M. E.

MANY processes of manufacturing require for best results, natural illumination consisting of sufficient and well-diffused daylight with, at the same time, however, the important limitation that little or no direct sunlight shall fall upon the working plane.

That is, there is a sharp disinction between daylight and sunlight and their relative desirability. The former consists of illumination by reflected and refracted light, properly designed fenestration, resulting in an evenly distributed, well-diffused light with consequent lack of sharp shadows and contrasts. The latter, or illumination by direct sunlight, is objectionable for many reasons of varying relative importance, such as the following: Its heating effect, especially in warm, southern climates; its color, which has a sensation value containing a greater proportion of red rays than daylight; its actinic effect upon materials used in manufacturing processes; and the fact that it is unidirectional and of excessive intensity, resulting in glare, sharp shadows and contrasts.

Diffusion of daylight in sawtooth buildings is obtained by placing the sawteeth so that the glass or lighting area faces the northern sky; sufficient intensity being dependent, among other things, upon the size and slope of the lighting area. Evenness of distribution is procured by properly apportioning the lighting areas. The amount of direct sunlight admitted daily, the time of its admission, and its duration are evidently dependent upon three considerations, the last two of which may be varied within certain practical limits. They are (a) The day of the year, determining as it does the sun's path across the sky; (b) The direction in which the lighting area faces as regards the points of the compass; (c) The slope of the lighting area.

For a given lighting area, a variation in its slope is accompanied by a very appreciable change in the amount of daylight admitted, as will be demonstrated later. That is, as the pitch of the lighting area is made steeper, the amount and duration of direct sunlight entering the building is lessened, and at the expense of the general illumination. Conversely, as the slope of the lighting area is decreased, the intensity of daylight is correspondingly increased, but there also is concurrent therewith a greater amount and duration of direct sunlight.

The question then becomes: How steep should this slope be? What is the proper balance between the two contending requirements of little sunlight and much daylight? Also at what time of day will the direct solar rays fall upon the working plane, in what locations and volume, and for how long a period?

Naturally, no general answer can be given to these questions. Each individual problem should be worked out only after careful study has been made of the particular conditions and requirements which have to be met, not excluding first cost. In the Southern states, for example, the tendency is to adopt a more nearly vertical lighting area than in the northern part of the United States or Canada, on account of the greater al-

titude of the sun and its intense heat. Occasionally it has been found advantageous to so locate machinery as to avoid any direct sunlight during the working hours.

With a view, therefore, to clearing up such questions as these, the writer's firm, F. P. Sheldon & Son, undertook to work out, in conjunction with what empirical data they already had, a rational method of design for sawtooth-roof construction.

The subject is necessarily divided into two closely related parts, the first concerning direct sunlight, its amount, time of admission, duration and location on the working plane; the second part relating to intensity of daylight upon the working plane.

Part I. The Orientation of Sawtooth Buildings and the Slope of the Lighting Area as Related to the Requirements of Least Direct Sunlight

In the practical problem of the sawtooth roof, the effective slope or vertical angle of the lighting area,



on account of projecting jets, gutters, and sash rails, and the interference of roof rafters, etc., is greater than the pitch of the glass itself. This often amounts to as much as 7° or 10°. Similarly the horizontal angle or bearing of the lighting area with respect to the sun's rays may be greater or less than the normal angle on account of projecting vertical sash bars, etc. This difference often amounts to as much as 5° or 8°.

The position of the sun at any given time depends upon the latitude of the place, time of day, and calendar date, and may be obtained from standard altitude and azimuth tables. Knowing this, the time of admission and duration of direct sunlight for any day of the year may be calculated as follows:

In Fig. 1, let the plane determined by the three points, A, C and D represent the lighting-area plane, and let points A, B and E define a plane parallel with the horizon. These two planes intersect in line AF. The acute angle v is then the effective slope or vertical angle of the lighting-area plane. Also let line AB represent the horizontal direction or bearing of the sun with respect to the building at any assumed calendar date and time. That is, angle h = the difference between the sun's true bearing or azimuth and the true corrected bearing or azimuth of the lighting-area ridges, each azimuth being read easterly or westerly or westerly from north, according to whether morning or afternoon conditions are being computed.

Now pass plane ABC through AB perpendicular to

*Presented at Annual Meeting American Society of Mechanical Engineers

plane ABE, cutting the lighting-area plane ACD in line CD. By construction this plane also contains the sun's altitude line through point A. Consequently, it is evident that if vertical angle x is greater than the altitude of the sun, a condition of total shade exists within the building at the given time. And contrariwise, if x is less than the solar altitude, the sun is in front of the plane of the lighting area and some direct sunlight is entering the building.

Now, to find x in terms of v and h (see Fig. 1),

$$\begin{aligned} \text{and } AE &= ED \cot v \\ AB &= ED \cot x \\ \text{and } \cos(90 - h) &= \frac{AE}{AB} \end{aligned}$$

Substituting in the last equation the values of AE and AB .

$$\cos(90 - h) = \frac{\cot v}{\cot x}$$

$$\text{whence, } \sin h = \frac{\cot x}{\cot v}$$

$$\text{and } \tan x = \sin h \tan v \dots \dots \dots (1)$$

From the above equation, exact information may be obtained as to the time of admission of direct sunlight and the number of hours of its duration. The following example illustrates the method of procedure:

Example 1. Given, a sawtooth building located in north latitude 36° . Orientation of building is such the azimuth of sawtooth ridges = $90^\circ 08' \text{ E.}$ Angle of glass = 73° . Required, to find sunlight conditions on June 10 (sun's declination 23° No.)

By inspection, according to azimuth tables, sunlight will enter the building from sunrise until at least 9.20 a.m. apparent time, because the sun's azimuth up to that time is less than that of the sawtooth ridges. The method now consists in finding by trial at what time the sunlight entirely disappears from the shed.

Assume 10.20 a.m., at which apparent time, according to the tables, the sun's azimuth = $114^\circ 08' \text{ E.}$, and its altitude $64^\circ 46'$. Now, $v = 73^\circ$ plus a correction for projecting jets, gutters, etc., as previously explained. (This may be found from detailed section of building and will here be assumed as 7° .) Then $v = 73^\circ + 7^\circ = 80^\circ$. Applying the correction as explained above:

$$h = 114^\circ 08' - (90^\circ 08' - 5^\circ) = 20^\circ.$$

$$\begin{aligned} \text{Substituting in Equation (1),} \\ \tan x &= \sin 20^\circ \tan 80^\circ \\ \text{whence } x &= 62^\circ 43'. \end{aligned}$$

Since x is $0^\circ 31'$ greater than the solar altitude, it is greater than x , a small angle of sunlight is entering the shed. The above process may be repeated with a slightly larger assumed value of h , with the result that within a few minutes all direct sunlight will be found to be entirely excluded from the building.

To obtain afternoon conditions, the operation should be further continued until such time as sunlight is found to re-enter. In this case, instead of assuming the time and computing h , the reverse method will be pursued and, as a further short cut, it may be reasoned that since the lighting area faces slightly toward the east (that is, $N, 9^\circ 8' \text{ E.}$), h at the transition period will be less than in the morning.

The westerly azimuth of the sawtooth ridge is now used for reference with the tables and equals $90^\circ 0' - 9^\circ 8' = 80^\circ 52'$. Try $h = 6^\circ$, at which time the sun's azimuth becomes $(80^\circ 52' - 5^\circ) + 6^\circ = 81^\circ 52'$. the

apparent time being, from the tables 4.34 p.m., and the sun's altitude being from the tables $30^\circ 10'$. From Equation (1).

$$\tan x = \sin 6^\circ \tan 80^\circ$$

$$\text{whence } x = 30^\circ 41'$$

Since x is $0^\circ 31'$ greater than the solar altitude, it is evident that no direct sunlight is entering. However, this angular difference is very slight and if the computations were carried on a step further sunlight would be found to come in approximately five minutes later.

In this case then, on June 10 a condition of total shade exists within the building from approximately 9.20 a.m. until 4.30 p.m., apparent time. Where the apparent time is different from standard time, the proper allowance should, of course, be made. Furthermore, an additional correction must be applied in places where the daylight saving plan is in effect.

Generally it will be found advisable to solve a given problem for at least two sets of conditions, that of the longest day of the year (June 21, declination $23\frac{1}{2}^\circ \text{ N.}$) and the average day of the year (March 21 and Sept. 23, declination 0°).

In the example above, it will be noted that the duration of total afternoon shade is 4 hr. and 34 min. and is considerably greater than the duration of morning shade, which is only 2 hr. and 40 min. This is due to facing the lighting area slightly, ($9^\circ 8'$) toward the east, and suggests quite a range of possibilities as regards orientation.

By applying the principles of descriptive geometry, the amount and location of direct sunlight at any given time may be obtained, if desired, by finding the lines in which the solar rays through the top and bottom limits of the lighting area intersect the working plane—the direction of these rays being taken from altitude and azimuth tables. It may also in this case be necessary to include the effect of side walls, division walls, etc.

For convenience, Table 1 is appended, giving different values for x for assumed values of h as applied in the second method of Example 1. Its use makes unnecessary any reference to trigonometrical tables, unless closer results are desired, for angles not given.

Table I.
Showing Values of (x) in Terms of (h) and (v)

h°	x for $v = 70^\circ$	x for $v = 75^\circ$	x for $v = 78^\circ$	x for $v = 80^\circ$
3	$8^\circ 11'$	$11^\circ 03'$	$13^\circ 50'$	$16^\circ 30'$
5	$13^\circ 28'$	$17^\circ 59'$	$22^\circ 18'$	$26^\circ 16'$
7	$18^\circ 29'$	$24^\circ 28'$	$29^\circ 52'$	$34^\circ 36'$
10	$25^\circ 30'$	$32^\circ 57'$	$39^\circ 24'$	$44^\circ 32'$
15	$35^\circ 28'$	$44^\circ 01'$	$50^\circ 40'$	$55^\circ 44'$
20	$43^\circ 15'$	$51^\circ 55'$	$61^\circ 05'$	$62^\circ 43'$
25	$49^\circ 15'$	$57^\circ 36'$	$63^\circ 20'$	$67^\circ 22'$
30	$53^\circ 59'$	$61^\circ 49'$	$66^\circ 59'$	$70^\circ 34'$
35	$57^\circ 36'$	$64^\circ 58'$	$69^\circ 41'$	$72^\circ 56'$
40	$60^\circ 30'$	$67^\circ 22'$	$71^\circ 42'$	$74^\circ 40'$
50	$64^\circ 36'$	$70^\circ 43'$	$74^\circ 30'$	$77^\circ 03'$
60	$67^\circ 15'$	$72^\circ 48'$	$76^\circ 12'$	$78^\circ 30'$
70	$68^\circ 49'$	$74^\circ 05'$	$77^\circ 18'$	$79^\circ 22'$
80	$69^\circ 44'$	$74^\circ 47'$	$77^\circ 50'$	$79^\circ 52'$
90	$70^\circ 00'$	$75^\circ 00'$	$78^\circ 00'$	$80^\circ 00'$

A committee composed of representatives of advertising clubs, the Canadian Manufacturers' Association, the Toronto Board of Trade, the Rotary Club, and various other associations has been formed for the purpose of laying the foundation of a publicity campaign to be launched shortly to advertise Toronto.

Recent Harbor Improvements at Hamilton

By John Taylor, C. E.

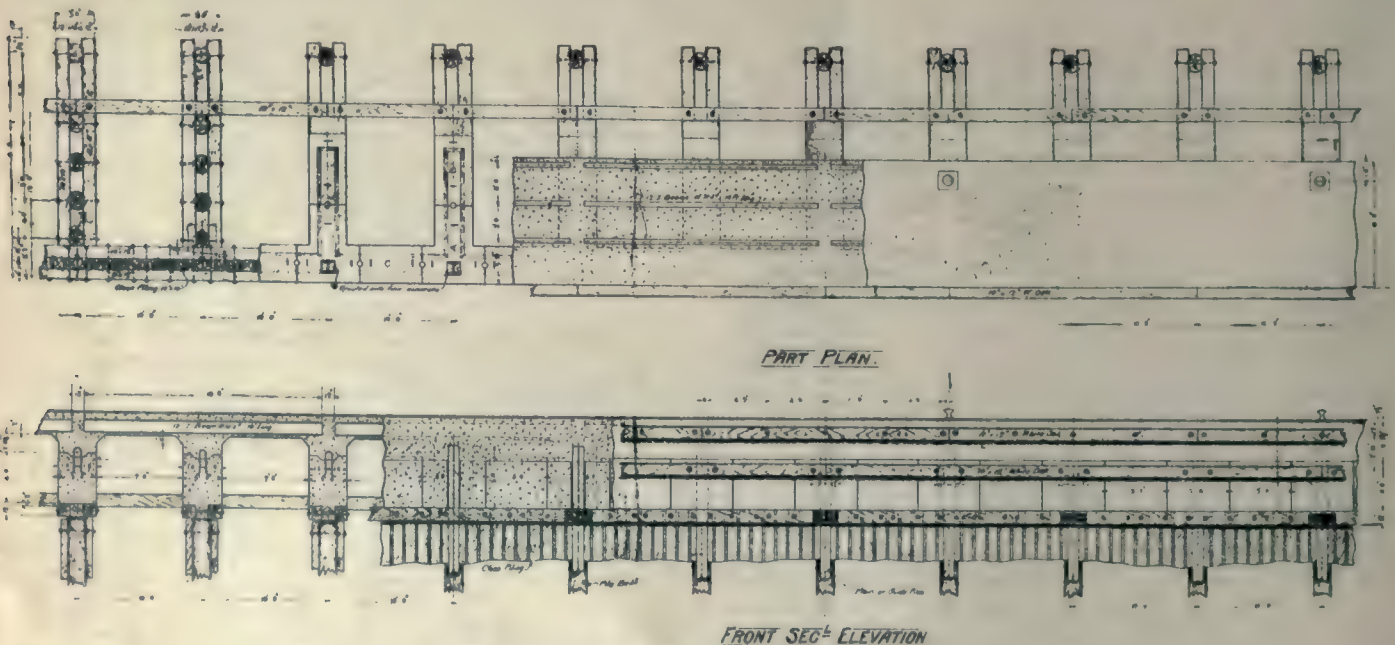
WITH the object of completing the construction of the existing Harbor Commission wharf wall, (locally called the Revetment wall), and the reclamation of the enclosed area behind the wall, the contract was awarded early in 1913 for an extension to the wall 1,600 feet long, and about 400,000 cubic yards of dredging and filling.

The wall existing at that date, shown on Figure No. 1, was about 1,00 feet of Ferguson Ave., running in a direction approximately parallel to the city water front. This existing section built about 1905, consisted of a wall built with wood pile bents faced with steel sheet piling 30 feet long to retain the dredged fill placed behind the wall, and finished from lake zero level upwards with a concrete block and mass concrete superstructure. The bents were driven about 10 feet apart, five piles, 30 feet long to each bent, spaced to give a width of bent 16 feet long crossways to the wall. Square timbers 12 inches by 12 inches in section were bolted to each side of the pile bents to form a seat for the concrete blocks. Timber stringers tie the bents together longitudinally and sway bracing is bolted on each side of the bents to stiffen them against side pressure against the wall. The steel piles are carried up to the roadway level, which is about 5 feet, 6 inches above lake zero level, and are bolted to the timber stringers attached to the piles under water, and

the area has been reclaimed by using it as a city refuse dump.

With the exception of a strip 100 feet wide, immediately behind the wall which is retained for dockage purposes, the area behind this portion of the wall is owned by the City of Hamilton and has been converted into a public park.

The new section of wall, work on which was commenced early in 1913, extends for about 500 feet eastward from the line of Ferguson Ave. to the continuation of the line of Wellington Street. At this point it turns at approximately a right angle and runs shoreward for a distance of about 1,100 feet to the east side of Wellington Street. The 500 feet above referred to and a length of 400 feet from the angle shorewards is faced with Lacakawanna steel sheet piling of heavy arched web section 30 feet long with each tenth pile 40 feet long, the total weight of steel piling used being about one and a quarter million pounds. This section of wall, (see drawing No. 2), is of the same general design as the original part built, with the exception that the steel piling is of a different type, and 40 foot piles are introduced at intervals. The wood piles in the supporting pile bents are also longer on account of the softer nature of the bottom, running up to 55 feet long in some cases, with 16-inch diameter butts and 8-inch diameter tops. A change was also made in



Part Plan and elevation of revetment wall, Hamilton, Ontario.

also to the concrete superstructure. The sheet piling is of the built-up, riveted type called Friedstedt Piling, which was in common use before the advent of the unit rolled steel piling sections now universally in use. Two continuous 10 in. by 12 in. oak fenders are belted on the face of the steel piling above the water level.

Fill from the front was placed behind the wall in this first section built by a floating clam shell derrick, and then levelled off, and a considerable portion of

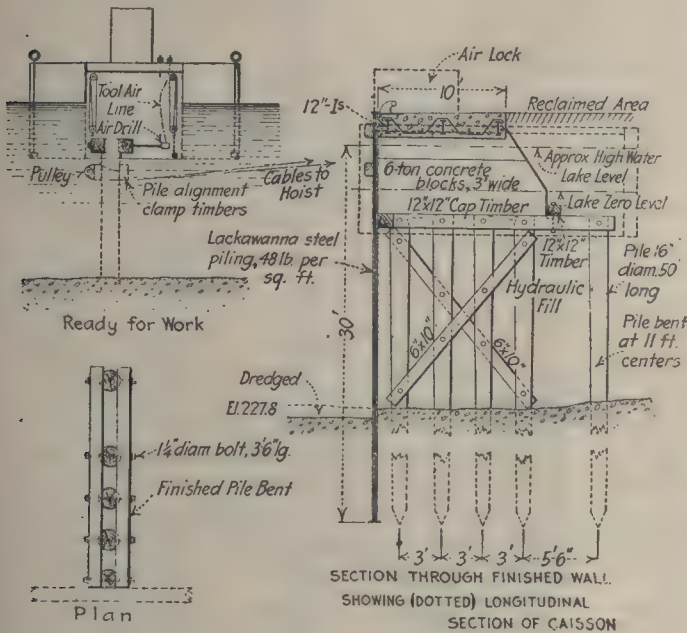
the design which added very materially to the difficulty of constructing the wall compared to the first part built. The pile bents in the new section are cut off and capped at a depth of 1 foot 9 inches below lake zero level, which necessitated the framing of the timber and bolting the piling in water ranging from 2½ feet to 20 feet in depth, depending on the lake level, which, of course, fluctuates throughout the year. Anyone with practical experience of this kind of work will appreciate what this difference means in con-

structing what is practically a heavy trestle entirely under water.

The advantage of this change in design is that it keeps all the wood work substructure in the wall well below the extreme low water level, so that it is not exposed in any part of it to alternative wetting and drying, with the resultant well known decaying action. Wood, of course, if kept continually below water, will last almost indefinitely, while the life of that around the water level and above water, when exposed to

10 feet wide spanning the concrete blocks and reinforced by steel girders and wire mesh.

The enclosed area behind the wall was reclaimed by material dredged from the Bay in front of the walls and was deposited in position partly by a 20 inch suction dredge, and partly from dump scows from a four yard dipper dredge. When the dredged fill behind the wall was carried up to about three feet above low water level, thus filling in and consolidating around the pile bents, anchor rods of 2 inch diameter steel with turnbuckles were placed running through the wall to wooden deadmen set in the fill at 10 foot centers, fifty feet back from the wharf line. This was done with the idea of relieving the wall of part of the heavy lateral thrust from the wet fill placed behind it by the hydraulic method. In the first section built about 1905, a stone fill bank was placed immediately behind the wall and the earth fill was placed by clam shell so that the pressure during construction was reduced. The hydraulic method of placing fill, especially if it is of a soft clay or muddy nature brings very heavy stress to bear on a wall of this type, which has comparatively small dead weight, causing an unbalanced load outwards during construction, which is approximately equivalent to the resultant thrust of loose material weighing 50 pound per cubic foot with an angle of repose of about 20 degrees from the horizontal under water, so that the design of a wall of this type under such conditions, requires careful consideration and intelligent placing of the fill, and presupposes practically faultless construction of the submerged timber portion. This is almost impossible of attainment unless the work is done in the dry. This method was obtained by using the caisson above referred to, with the result that the under water work was inspected and passed without question as the work progressed and without the pos-



Cross Section of revetment wall.

water action, and the action of the elements is not more than about ten or fifteen years, depending on the timber used. Rapid deterioration generally commences in about ten years in fresh water. This decaying process is a natural one induced by the action of the sun, the air, and water and ice, and is not complicated in the great lakes where the water is fresh, by the action of wood devouring worms such as are to be found in salt water.

In order to carry out this under water timber construction expeditiously and economically, and get away from the necessity of using ordinary helmet divers, the writer, who had charge of the construction, devised a water ballasted floating pneumatic caisson, under which most of the timber work was done in sections in the dry with comparative ease.

As an illustration of the comparative speed of doing this kind of work by these two methods, namely, by a diver and by a caisson of this type, when the framing up of the wood substructure was first commenced, a diver spent a whole week on one pile bent and got practically nothing done to it, while the caisson and its crew, completed two bents per day. This caisson was illustrated and described in the November 6, 1918, issue of Contract Record.

The section of the inner end of the wall 700 feet long, was built with wood sheet piling and pile bents cut off at 1 foot 9 inches below lake zero level, with a steel girder sheet pile every 10 feet, and capped with concrete blocks and mass concrete. (See drawing No. 3.)

The mass concrete deck consisted of a 12 inch slab,



View of steel piling and concrete foundations.

sibility of the quality of the work being questioned in any way at a later date, thus relieving the contractor of an undesirable responsibility. Instances will readily occur to anyone interested in this kind of pile substructure dockwall construction, where difficulty on account of submerged timber construction has been met with on works recently carried out. This question is of primary and vital importance in such work, and does not generally receive the consideration by contractors and others which it requires to ensure successful and

satisfactory completion of the work. The saying about the man who built his house upon the sand, applies in a sense to this kind of work as it is not sufficient to simply prop up the under water part of this kind of dock wall and be satisfied, so long as the top above water looks nice and pretty.

All the land area reclaimed behind the new section of the wall is under the jurisdiction of the Hamilton Harbor Commission, having been turned over to the Commission by the Government on completion of the work. This wall, together with the portions previously completed, and shown on figure No. 1, gives a total length of about 3,500 feet of dock wall, with water along side varying from 18 to 20 feet deep.

Canada Steam Ship Lines Limited makes use of a section with warehousing accommodation at the western end, while Imperial Oil Limited has dockage and pumping connection through oil pipe lines from their tank steamers on the new eastern section at the foot of Wellington Street to their recently constructed oil storage tanks at the new storage and distributing station on Victoria Avenue, at a point about one half mile from the water front.

The approximate total expenditure on these dock walls, warehouses, etc., has been about \$500,000.00 and they will no doubt form the nucleus of what will ultimately become a continuous development of the city water front, by the construction of wharf walls and dredging, and the reclamation of submerged and low areas which at present are lying to a great extent useless and retard development and depreciate the value and utility of the water front lands of the City of Hamilton.

The dock walls, above described, were designed by and built for the Department of Public Works, Mr. Eugene D. Lafleur being chief engineer, and Mr. J. H. Sing, and latterly Mr. J. M. Wilson, being district engineers. The writer had charge of the construction work for the contractors.

The Harbor Commission who control and administer the property, consist of Mr. A. C. Garden, Mr. Geo. J. Guy, and Mr. Wm. Clark. Mr. H. E. Waterman is the secretary of the Commission. The energy and public interest of Mr. T. J. Stewart, M.P., for West Hamilton was largely instrumental in having the new work carried out. The business interests of the City of Hamilton generally, now have more ambitious schemes in view for the development of the water front of the city. Now that the war is over, these schemes will no doubt materialize at a not very distant date.

December Building Activities

Activities in the building trades, as indicated by the value of building permits issued in 35 cities, showed a decline during December, 1918, as compared with the preceding month, the total value of building permits falling from \$2,387,045 in November, to \$1,640,727 in December, a decrease of \$746,318, or 31.3 per cent. Saskatchewan, British Columbia and Ontario, (where the gain was very inconsiderable), reported increases in comparison with the previous month. As compared with the corresponding month in 1917, there was an increase of 87.6 per cent., the value for December, 1917, being \$874,689. All the provinces recorded gains in this comparison.

Of the larger cities, Toronto and Vancouver showed increases both as compared with the preceding month and with December, 1917, while Montreal and Winnipeg reported declines in comparison with Novem-

ber, but increases over December, 1917. Of the smaller centres, Fort William, Ottawa, Moose Jaw and New Westminster all showed increases in both comparisons.

Estimate of Building Work as Indicated by Building Permits Issued in Thirty-five Cities

City	December, 1918	December, 1917	December, 1918, compared with December, 1917	
			Increase (+) Amount	Decrease (-) Per cent.
Nova Scotia	\$88,706	\$24,399	* \$64,316	* 263.69
Halifax	74,390	13,255	* 61,135	* 461.22
Sydney	14,316	11,135	* 3,181	* 28.56
New Brunswick	5,825	2,825	* 3,200	* 121.98
Moncton	5,825	1,125	* 4,700	* 417.78
St. John .....	.....	1,500	.....	.....
Quebec	192,420	132,610	* 59,810	* 46.19
Montreal-Maisonneuve	176,045	56,270	* 119,775	* 212.86
Quebec	5,575	8,440	† 2,865	† 33.94
Sherbrooke .....	.....	.....	.....	.....
Three Rivers	5,600	50,000	† 44,400	† 88.50
Westmount	5,200	17,900	† 12,700	† 70.95
Ontario	1,140,533	620,485	* \$520,048	* 83.21
Bramford	1,565	149,915	† 148,350	† 98.06
Fort William	54,365	850	* 53,515	* 6,295.87
Guelph	350	150	* 200	* 133.33
Hamilton	300,900	26,450	* 283,450	* 1,071.04
Kingston	8,548	9,607	† 1,059	† 11.02
Kitchener	400	.....	400	.....
London	27,980	34,500	† 6,510	† 19.11
Ottawa	58,163	11,100	* 47,063	* 423.90
Peterborough	3,175	335	* 2,840	* 847.76
Port Arthur	4,721	2,740	* 1,981	* 72.30
Stratford	35	790	† 755	† 85.57
St. Catharines	15,545	8,215	* 7,330	* 89.23
St. Thomas	8,500	800	* 7,700	* 962.50
Toronto	610,451	370,358	* 240,093	* 64.83
Windsor	36,835	4,585	* 32,250	* 703.38
Manitoba	10,150	9,600	* 550	* 5.73
Brandon	300	.....	300	.....
Winnipeg	9,850	9,600	* 250	* 2.60
Saskatchewan	62,160	12,584	* 49,576	* 39.32
Moose Jaw	47,950	800	* 47,150	* 5,893.75
Regina	5,160	7,050	† 1,890	† 28.91
Saskatoon	9,050	4,734	* 4,316	* 91.17
Alberta	37,100	10,200	* 26,900	* 263.72
Calgary	27,800	10,200	* 17,600	* 167.64
Edmonton	9,800	.....	9,800	.....
British Columbia	103,823	62,125	* 41,698	* 56.25
New Westminster	11,440	1,600	* 9,840	* 615.00
Vancouver	81,653	56,295	* 25,358	* 45.04
Victoria	10,740	4,300	* 6,440	* 149.77
Total—35 cities	\$1,640,727	\$874,689	*\$766,038	* 87.61

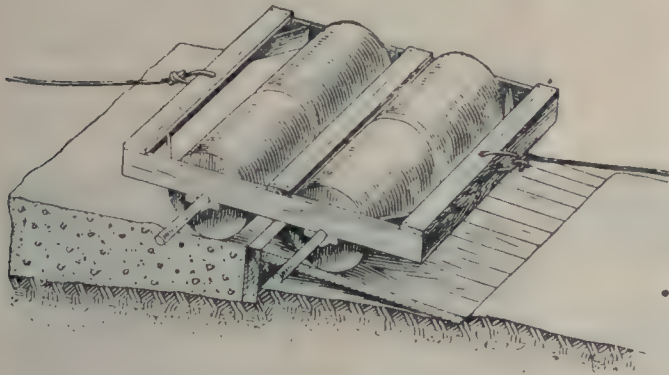
New Book

American Highway Engineers' Handbook—Editor in Chief, Arthur H. Blanchard; John Wiley & Sons, New York, publishers. This is the first edition and promises to fill the needs of the highway engineer as completely as Kidder and Kent do in their respective fields. In his preface the editor in chief states that he has kept in view the publication of a reference book which would include reliable and comprehensive information on all branches of highway engineering and relating subjects, which would prove useful to highway officials, engineers, chemists, contractors and engineer-salesmen of highway materials and machinery. That he has succeeded in covering this field as thoroughly as possible in one volume may be understood from the table of contents. The book is divided into twenty-nine sections under the following headings: Terminology of highway engineering; Mathematics, mechanics and structural materials; Engineering geology; Preliminary investigations; Surveys and office practice; Planning of roads and road systems; Planning of streets and street systems; Grading, drainage and foundations; Earth and sand-clay roads; Gravel roads; Broken stone roads; Bituminous materials; Dust prevention by the use of palliatives; Bituminous surfaces; Bituminous macadam pavements; Bituminous concrete pavements; Sheet-asphalt and rock asphalt pavements; Wood block pavements; Stone block pavements; Brick pavements; Cement-concrete pavements; Street cleaning, collection and disposal of waste, snow removal; Car tracks and pipe systems; Comparison of roads and pavements; Sidewalks, curbs, gutters, highway signs, etc.

Double Roller and Long Board Float Give Superior Road Finish

EXCEPTIONALLY good finish on a concrete road built at Camp Sherman, Ohio, was secured by using a double roller and long board float. The roller and the float were built on the job and are described by Samuel P. Baird, in a recent issue of the Engineering News-Record.

At Camp Sherman the warehouse street has two 30-ft. pavements separated by a 10-ft. utility space for pipes and poles. The pavements have no crown, but for proper drainage received transverse grades of 6 in. in 70 ft. to 17 in. in 70 ft. The slabs were built in lengths of a day's run, the longest being about 135 ft. The side forms were 2 x 6 in. x 16-ft. Southern pine planks. As the forms were left in place to protect the edge of the slab, their construction was unusual. To insure exact elevation, the side planks were supported on 2 x 4 x 12-in. blocks set 3 ft. apart and tamped to solid bearing in the ground. Thin wedges



Road Roller for Finishing Concrete Roadway

on the blocks adjusted the plank to exact elevation, and stakes held it upright. To hold the planks close to the slab edge when the stakes were removed, $\frac{1}{4}$ -in. wire ties 3 ft. long were inserted 3 ft. apart along the edge of the slab.

After the concrete had been struck off with an extra heavy strikeboard it was compacted by the double roller shown by the drawing. Four 28 x 18-in. rollers were made of No. 18-gauge galvanized iron shaped in a bending roll. Each roller had a $1\frac{3}{4}$ -in. solid head in each end, made of two $\frac{7}{8}$ -in. boards that were placed with the grain crossed.

There were also intermediate heads $\frac{7}{8}$ in. thick. These heads were sawed out on a band-saw. The center hole was a loose fit on a 1-in. pipe. Between the rolls and between the rolls and the frames were placed $\frac{7}{8}$ -in. wood washers. The pipe axles were rigid in the frame and extended beyond the frame, for use as convenient handles. All the frame material was $\frac{7}{8}$ in. x 4 in. cypress. When completed the roller weighed 105 pounds.

The location of this work was so restricted by warehouse platforms on one side and a very busy street on the other, that the use of a roller with a handle was out of the question; also, a single roller hauled by ropes did not give satisfaction, so the double roller was designed.

The split feature was the result of an afterthought; we could not find a bending roll to handle anything wider than 28 in., nor could we get the material, No. 18-gauge, any wider than the standard sheets.

To get best results, there should be placed at each side of the road temporary strips outside the side forms, as shown by the sketch, so that the front roller can be readily pulled over the side forms. In this way any water which is ahead of the second roller can be forced over the forms.

Removal of the water is one of the objects of rolling concrete. Another good result is the crowding down of the coarse aggregate slightly below the surface, thus permitting the ready use of a float 2 ft. longer than the road is wide, and made of some light wood from $\frac{1}{2}$ to $\frac{3}{4}$ in. thick and 8 to 10 in. wide. The results are more satisfactory than those given by a belt. At Camp Sherman the float used was a cypress board $\frac{1}{2}$ x 6 in. and 32 ft. long, composed of two 16-ft. pieces spliced on top. The split-roller idea is of no practical use, in my opinion, as the roller—whether pulled by ropes, as in the case in question, or by a handle—is not easily controlled as to direction of movement, and any rolling close to the expansion joints tends to get them more or less out of line.

Archibald & Holmes in New Quarters

Due to the large amount of business handled by Messrs. Archibald & Holmes Limited, of Toronto, during the past year and a half, they have found it necessary to obtain larger office accommodation, and on the 1st inst. they moved from their original location, at 402 Excelsior Life Building, to a larger suite of offices at 306 Continental Life Building. Some of the work which this firm has on hand, and has completed during the past eighteen months is as follows. Administration Building, Toronto Harbor Commissioners; Cooler Building, Swift Canadian Co. Limited, Toronto; stock pens, Union Stock Yards Co. Limited, Toronto; flour mill and grain elevator, Hunt Brothers Limited, London, Ont.; grain storage tanks, Kellogg Toasted Corn Flakes Co., London, Ont.; elevator, Credit River Milling Co., Credit River, Ont.; Runnymede Road subway, Canadian Pacific Railway, West Toronto; office building, Standard Bank of Canada, Chatham, Ont.; office building, Merchants Bank of Canada, Niagara Falls, Ont.; office building, Bank of Nova Scotia, Halifax, N. S.; terminal elevator, Campbell Flour Mills Co., Toronto; manufacturing plant, W. Harris & Co. Limited, Asbridge Bay, Toronto; reconstruction work, Halifax, N. S.

At a meeting in the Board of Trade rooms in Nelson, B.C., recently, it was resolved to petition the Dominion government with reference to the building of an all-Canadian transcontinental highway, which in British Columbia would pass through the Crows Nest Pass, Fernie, Elko, Bull River, Cranbrook, Moyie, Yahk, Creston, Balfour, Nelson, Trail, Rossland, Cascade, Grand Forks, Princeton, and on to the coast. A meeting is to be held to discuss this question with boards of trades of other cities.

According to statistics compiled from reports of the fire marshals of the various states and presented at a recent conference between representatives of the Fire Marshals' Association of North America and the National Board of Fire Underwriters, the annual property loss by fire in the United States is approximately \$250,000,000, and the toll of lives taken each year exceeds 15,000—mostly women and children.

An Unusual Bridge Design

THE bridge illustrated herewith has just been completed over the Mahoning river, Ohio, and is of attractive design. The grade line, which was amply high to escape high water, nevertheless offered but a small under clearance in comparison with the width of the channel. The sub-foundation was such as to require piling. These two conditions, together with waterway requirements, seemed to make a concrete barrel arch impracticable.

In designing the reinforced concrete bridge illustrated here, the ends for a length of two panels were considered as concrete beams or girders and proportioned to resist the shearing forces. The central seven panels were considered as an arch and the arch rib was proportioned to withstand the bending stresses incident to unsymmetrical loading independent of the stiffness of the hangers, bottom chord and the floor.

In order to realize assumptions that were made as to the point of application and direction of reactions and also to avoid temperature stresses and a tendency of the bridge seat to spall off by reason of eccentric loading and contraction of the superstructure, a cast steel roller was designed for one end and a compar-

$$\frac{\sum M_2 y ds - H y ds}{E_2 I} = \frac{H i}{A_2 E_2}$$

ds—the length of one of a number of equal divisions into which the arch rib was divided.

E_2 —modulus of elasticity of the concrete in arch rib.

M_2 —moment of known external forces about the centre of a particular ds division.

y—the distance from the centre of bottom chord to the centre of corresponding ds division.

I —moment of inertia of the arch rib section about its horizontal axis.

i—length of bottom chord subject to stretch (taken as 50 ft.).

A_2 —area of bottom chord steel.

E_2 —modulus elasticity of bottom chord steel.

The maximum eccentricity of arch thrust with full live load of 100 pounds per square foot occurs at the crown. Here the thrust line is less than three inches above the center of the section. The maximum eccentricity of arch thrust with one-half live load occurs on the loaded half at the first hanger from the end. Here the thrust line is less than 8 inches above the center of the section. The resulting maximum calculated stress in concrete is less than 725 pounds per square inch and the arch reinforcing steel, though less than 1/3 of 1 per cent. of the sectional arch, is stressed less than 3000 pounds per square inch.

In the mind of the designer, one of the principal

A Combination
of Girder and
Arch Design



atively narrow lead strip placed for bearing at the fixed end.

The arch rib was proportioned on the assumption that it would deform under load as a two hinged arch, the span being taken as the distance from center of roller to center of lead bearing, the horizontal thrust in the middle seven panels of the bottom chord.

It might seem that rib shortening of the arch should properly have been considered and added arithmetically to the bottom chord stretch, but since the bottom chord steel is encased in concrete, which is cast integral with the concrete floor slab and since this condition tends to reduce the chord stretch by an indeterminate amount, it was thought proper to neglect the effect of rib shortening.

While the span of the arch was taken as above stated, the end section, whose depth is great in comparison with the depth of the arch rib proper, was assumed to be incapable of bending, or in other words, the reciprocal of its moment of inertia is small and was neglected. To determine stresses the size of members were assumed, loads and reactions were calculated, and the value of the bottom chord stress, H , was obtained from the following formula:

problems involved, was a method of constructing the bottom chord. No mill or warehouse was found which could furnish full-length bars. The use of shorter bars connected with turnbuckles was considered, but this would require sending the bars to a plant equipped for upsetting and threading, therefore, it seemed desirable to avoid the expense incident to that operation and also the expense of turnbuckles. The lapping of bars, which is common in beams, was not thought to be adequate in this case, particularly since the bars are all stressed to their full safe capacity throughout their entire length, and since there is such a large number to be encased in a comparatively thin envelope of concrete. Welding was considered but discarded because of unfavorable experience with this method of joining bars subject to direct tension. It was decided to take advantage of the mechanical anchorage offered by the lugs on a corrugated bar and to form a splice by gripping with clamps at five places on a 48 diameter lap. This extra precaution may thus be regarded as a special factor of safety over the common lap used in beams.

The floor system is proportioned to carry a pavement and a live load of 15 tons.

Method of Oilproofing Concrete

Various Integral and Surface Methods Being Investigated

A SERIES of experiments is being conducted at present by Ludwig Bloch and A. D. Hymen, water-proofing engineers for the Waterproofing & Construction Co., Inc., 50 E. 42nd Street, New York, to determine the most advantageous method of making concrete oilproof. The experiments, described in "Engineering World," are a continuation of similar experiments performed by Mr. Bloch for the Fougner Concrete Shipbuilding Co., of Christiania, Norway, and of New York, builders of concrete ships to be used as oil carrying tankers. It is said that the results from some of the experiments have had considerable influence on the methods adopted to oilproof the concrete ships that are being constructed.

The experiments are being conducted on cement-sand mortar proportioned about 1 part cement to 2 parts—by volume—of natural sand. A coarse aggregate was not chosen because it is not generally used in ship construction. Gasoline and 30 to 35 degrees Baume fuel oil, contributed by the Standard Oil Co., are being used in the tests. The mortar specimens consist of 2 by 3½-in. cylindrical disks and 1 by 2 by 4-in. parallelepipeds.

Two general kinds of experiments have been adopted. One consists of subjecting one side of flat specimens to oil under pressure; the other consists of immersing specimens in oil under pressure. The former is intended to determine the ability of the specimens to resist seepage, whereas, the latter is intended to determine the ability of the specimens to resist absorption. The disks are employed in the seepage tests and the rectangular specimens in the absorption tests.

Various kinds of oil-proofing are being investigated. The material includes that which is mixed with the mortar as an integral component and that which is applied to the surface of the specimen as a plaster coat or as a brush coat. Material which is mixed with the cement and sand is usually of an inorganic nature. The material in the plaster and brush coats, however, is varied. It includes special cements, oxides and other chemical compounds, paints of various kinds, varnishes and shellac. The plaster and brush coats are applied to that side of the specimen which is to be in contact with the oil.

The apparatus employed consists of vertical risers of 1/8 in. iron pipe, at the tops of which is a glass gauge about 2-ft. long, and at the bottom of which is a container for the specimens. The length of each riser is about 24 ft. When the specimen is in the container, oil is poured in the top of the pipe until the meniscus rises to a mark on the glass gauge. The amount of seepage or of absorption is determined by observing the glass gauge. Beakers are placed under the specimens tested for the seepage for the purpose of collecting any oil that may pass through them.

A feature of the experiments is the method employed to obtain a tight joint around the disks tested for seepage. Only those who have had experience with permeability tests of concrete appreciate the difficulty of obtaining a perfectly tight joint. Some experience is required in fastening the specimen in the apparatus if leakage is to be prevented. It has been observed that the number of leaky joints has dimin-

ished as experience in constructing the joint has increased.

To fasten the specimen in the cylindrical container, the top of the container is removed and the specimen is inserted. A rope of oakum is wound around the specimen and tamped solidly into the recess between the specimen and the container. Then the rope of lead wool is wound about the specimen and the lead is tamped thoroughly with a hammer and a caulking iron. The oakum and the lead wool are wound several times around the specimen to prevent the occurrence of vertical joints. Too vigorous tamping is likely to destroy the specimen. An experienced person, however, rarely destroys a specimen by tamping.

The containers have been made, generally, of galvanized iron of various weights. However, experience has shown that the containers made from heavier iron—about No. 20 gauge—are more economical than those made from the lighter iron. The reason for this economy is that the heavier containers can be used over and over again, many times, whereas the lighter containers can be used only two or three times. The necessary tamping of the lead wool causes a container to bulge and soon destroys the lighter one. What is more important than economy of container, however, is a tight joint around the specimen. This tight joint can be obtained by careful tamping.

Containers to hold the specimens consist of cylindrical drums of 1 cu. ft. capacity. Several 1 by 2 by 4-in. specimens are inserted in the drum, after which it is closed, and oil poured into the riser until the surface of the oil lift to the graduation on the glass gauge. To remove included air bubbles, the container is shaken gently and then allowed to stand during various intervals. Any absorption by the mortar specimens is indicated by the subsidence of the meniscus in the glass gauge.

Montreal Construction Interests Dividing Into Sub-sections

The Montreal district of the Association of Canadian Building and Construction Industries last week decided to form sections for the supply men, general contractors, and sub-contractors. Separate meetings of these branches were held at which the matter was discussed. At the meeting of the supply firms, Mr. W. E. Ramsey, the chairman, outlined the general purpose of the section, and said that while the Montreal Builders Exchange had done good work, times and conditions were changing, and as the result of the recent conference in Ottawa, it seemed desirable to form sections of the building and contracting trade which could deal with their own problems, while still being members of the central Canadian Association.

Nominations for the board of directors of the Association of Canadian Building and Construction Industries (Montreal Section) were as follows: W. H. Irving, president; J. P. Anglin, past president; J. K. McNutt, vice-president; J. E. Walsh, hon. treasurer; R. F. Dykes, hon. secretary; representing supply section, A. W. Bremner, John Grieve and A. F. Daly.

At the meeting of the general contractors, it was decided to nominate the following as representatives to the Montreal district; Messrs. John Quinlan, E. B. Evans, and Donald Church. Mr. J. Quinlan, presided, Mr. J. P. Anglin spoke along the lines of consolidating the various associations, so that by a co-operative effort mutual benefit would result to the industries.

Some Things the Contractor Often Overlooks

By Wm. F. Hildman, Concrete Road Contractor,
Chicago Heights, Illinois

UNTIL a short time ago overhead expense was something that the average business man thought he need not know anything about, and there are few lines of business that have not suffered at some time from the ravages of this unrecognized messenger of gloom.

When estimating on concrete highways it is proper to give attention to unexpected costs with which every job is more or less burdened. Let's start at the beginning and work through. Perhaps we can find some of the oversights that are frequently responsible for our coming out at the small end of the horn when the job is finished.

With the contract in your pocket, bond filed to cover, have you figured the interest on cost of check and cost of bond?

You ship machinery somewhere near the starting point of the job and when you expect it to arrive, your superintendent and a couple of your regular men are there waiting for it. Railroad fare, board and room, and freight bills start at this time.

The equipment arrives—some part is broken or damaged in transit. Another delay until either the local blacksmith can make the necessary repairs or new parts may be brought from somewhere in America—with cost of board and room and other expensive elements going on as usual.

Next is either a camping outfit or some means of conveyance to get men back and forth from the job. Oil, gasoline, tire, and many kinds of repair expenses are, among other things, in order. A night watchman, a man at the pumping house to keep the water coming through the roller or mixer have to be considered.

Telephone bills are incurred daily to keep material coming. Few days of rainy weather are scattered here and there throughout the period of the job. Roads are muddy, demurrage puts a blot on the profit side of the ledger. Either these, or no material at all, and regular men of the crew drawing their salary in the meantime.

Just as you are getting a good start, something happens with some part of the mechanical equipment. Flues commence to leak, possibly because of the quality of water you had to use. As there is no chance to send the gang home, you start in to work on the shoulders. Progress is slow, however, for most concreting gangs do not like building road shoulders, and as the concrete laid will not permit use of a wheeler or scraper, you are up against it.

About this time the party owning a water hole, from which you are getting your supply, wants pay for the water with chances that he wants as much for it as you are expecting in profit on the job. Never use a farmer's well until you have made a written agreement covering its use, knowing whether or not it is going to cost you something and how much.

Then there are those numerous things that can be grouped in no other way than by calling them incidentals. They all show up on every job and they all cost money.

We have depreciation, too. Isn't it a fact that we fool ourselves on this very important question? There seems to be a very large difference of opinion among road builders as to the amount to be charged for depreciation of road-building machinery and this is one of the real reasons why many contractors lose out financially in concrete road building.

Another important item that must not be overlooked is interest on balance held over from fall to spring on incomplete jobs. This is a very important expense for a contractor with limited capital.

The foregoing are merely a few reminders. Nevertheless, they are sure to be on almost every job. Are you sure that every time you bid you give them proper consideration?

At the annual meeting of the Ottawa Branch of the Engineering Institute of Canada, held in Ottawa, on January 9th, the following officers were elected for the calendar year 1919: R. deB. Corriveau, chairman; J. B. Challies, secretary; and as members of the Managing Committee, Messrs. A. F. Macallum, C. N. Monarrat, J. Blizzard, and G. B. Dodge.



H. T. Hazleton, President.

Two officials of the Winnipeg Builders' Exchange whose services have been recognized by re-election. Members of the Exchange are very optimistic regarding the prospects for 1919.



J. S. Hooper, Secretary.

The Wearing Resistance of Concrete

By Duff A. Abrams*

CONCRETE is widely used in the construction of floors, pavements, walks, loading platforms, and for other purposes requiring high resistance to impact and abrasive stresses. Such uses of concrete have emphasized the necessity for more complete information concerning the factors which affect the wearing resistance of the material. This information is being secured by means of experimental studies in progress at the Structural Materials Research Laboratory which form a part of the research work on the properties of concrete and concrete materials being carried out jointly by the Portland Cement Association and Lewis Institute. Several thousand wear tests have been made during the past three years; other studies of a similar kind are now under way.

With cement meeting standard specifications and high-grade aggregate mixed in definite proportions, the maximum resistance to wear can be secured by the following methods:

- (1) Reduce the mixing water to the smallest quantity which will produce a workable concrete;
- (2) Provide proper curing conditions so that concrete will not dry out too soon or be injured by traffic before thoroughly hardened;
- (3) Thoroughly mix the concrete.

Too much emphasis cannot be placed on the fundamental importance of proper control of mixing water. In many instances a large proportion of the cement is simply wasted, due to the use of too much water in the concrete. Tests made in this laboratory have shown that in a 1-sack batch each pint of water more than necessary lowers the strength of the concrete and its resistance to wear, the same as if we should omit 2 or 3 pounds of cement. The "sloppy" mixes frequently seen in floor and road construction may give concrete of less than one-half the strength and resistance to wear that should be secured at the same cost if proper care were given to proportioning the water.

It is impracticable to state in general terms the exact quantity of mixing water which should be used, since this depends on several factors, such as quantity of cement, kind, size and grading of aggregate, moisture contained in aggregate, etc. For the mix generally recommended for use in road construction, that is, 1 volume of cement to about 4 volumes of mixed aggregate (aggregate graded up to $1\frac{1}{2}$ or 2 inches), the water necessary to produce a workable mix will vary from $5\frac{1}{2}$ to 6 gallons for each sack of cement. Other factors being the same, the full utilization of the cement in the concrete depends entirely on the use of the smallest quantity of mixing water which will produce a concrete of satisfactory plasticity.

Increasing the quantity of cement in the concrete or improving the grading of aggregates is effective in increasing the resistance to wear only in so far as we

are enabled thereby to reduce the quantity of water as compared with the cement in the mix.

Ample moisture during the curing period is second in importance only to the use of a proper quantity of mixing water. The tests show that unfavorable curing conditions produce exactly the same effect as too much mixing water. However, the former factor is not at present subject to the same abuse as the latter. Many floor jobs are ruined due to failure to supply moisture for a few days after placing the concrete. The "ponding" method furnishes ideal conditions for the curing of floors and roads. A good rule to follow is: **"Mix with the smallest quantity of water that will produce a plastic concrete, then supply as much water as possible for curing."**

Traffic should be excluded until the concrete is thoroughly hardened; the length of time required will depend on the nature of the work, and the weather. Not less than one week should be allowed for curing in any case; for roads for vehicular traffic this time should be extended to 10 days or 2 weeks; under unfavorable conditions one month or longer may be necessary.

The concrete should be mixed in a batch mixer for a full minute after all materials are in the drum. The resistance to wear is materially lowered by undermixing. There is no danger that concrete will be mixed too long. However, it has been clearly shown that no reasonable increase in the mixing period will counteract the ill effects of too much mixing water.

Wear tests of concrete were made in the Talbot-Jones rattler. The test pieces consist of blocks 8 inches square and 5 inches thick. The blocks are arranged around the perimeter of the drum of the rattler; the ten-side polygon formed by the test blocks presents a nearly continuous surface. The outside diameter of the polygon is 36 inches and the inside diameter is 26 inches. During the test the front of the chamber is closed by means of a steel plate. The abrasive charge consists of 200 pounds of cast iron balls (about 133, $1\frac{7}{8}$ inches and 10, $3\frac{3}{4}$ inches in diameter).

The test consists of exposing the inner face of the concrete blocks to the wearing action of the abrasive charge for 1,800 revolutions of the drum at the rate of 30 r. p. m. The machine is run for 900 revolutions in one direction, then reversed. Duplicate rattler heads enable us to test two sets of blocks at the same time. For research work in studying the effects of varying proportions and consistency of the concrete, each block is made from a small batch of hand-mixed concrete. The specimens are molded in metal forms and finished with a wood float. Each block is weighed immediately before and after testing. The loss in weight is used as a measure of the wear. This loss is reduced to an equivalent depth of wear in inches.

Tests are now under way which are expected to bring out the relative merits of different aggregates for use in the construction of concrete floors, walks and roads.

*Professor in Charge, Structural Materials Research Laboratory, Lewis Institute, Chicago.

Mainly Constructional

East and West—From Coast to Coast

The shipyards at Collingwood, Ont., have orders on hand for five or six steamers.

At the recent municipal elections in Listowel, Ont., a by-law to raise \$18,000 for new roads was carried by a large majority.

The Discovery Mining & Power Co., Ltd., has been incorporated with a capital of \$20,000, head office at Prince Rupert, B.C.

The Ontario government proposes to erect another large building at the Kemptville Agricultural School. Work will proceed early this season.

By-laws to extend the street railway to Terrace Hill and to erect a new \$75,000 school were carried by the ratepayers of Brantford, Ont., at the recent elections.

Two hundred new houses and improvements at the sewage disposal plant are among the requirements of Stratford during 1919, according to Mayor J. L. Young.

Hutchinson Securities, Limited, has been incorporated with a capital of \$100,000, head office at Vancouver. The firm's charter permits it to engage in the building and real estate business.

Three branch lines of the government railways in Alberta will be built by 1920, according to recent statements by government officials. These are the Sangudo, St. Paul-De Metis, and Medicine Hat-Hanna branches.

A deputation from Parry Sound, Ont., recently came before the provincial government to request that the government either build a new road from Trout Creek to Loring or put the present road in good condition.

A Supreme Court writ for \$1,529.09 has been issued on behalf of the Canada Crushed Stone Corporation, Ltd., Dundas, against the Frid Builders' Supply Co. and J. E. Frid. The claim is for goods supplied and rent.

The International Diamond-Drill Contracting Co. has been registered as an Extra-provincial company in British Columbia, with local headquarters at Vancouver. The head office of this concern is at Spokane, Wash.

The total of the building permits issued in Sydney, N.S., during 1918 was 320, at a value of \$422,257, as against 247 at a value of \$416,900 in 1917. December's total was \$14,360, as compared with \$11,135 for the same month in 1917.

A committee is at work organizing for the promotion of a scheme for the construction of a provincial highway following the so-called "northern route." Stratford, Kitchener, Sarnia and New Hamburg are co-operating in this object.

It is stated that Bishop Fallon is preparing plans for a new quarter-million-dollar seminary, in London, Ont., this project having been postponed on account of the war. It will be located on a 20-acre site at the north end of Waterloo St.

In Smith's Falls, Ont., recently, the suburban area commission decided to call for tenders for 1,700 cords of stone for the building of the new road between that town and Port Elmsley. The improvement work will include the construction of a new bridge over Black Creek.

The Premier of Alberta recently stated that his government purposed building two sanitariums for civilian cases of tuberculosis in the province, if the plan jointly agreed upon with the Dominion Government was not carried out and the proposed hospital at Calgary begun next spring.

Canadian Pacific Railway surveyors are running a line

preliminary to the construction of a branch railway from Wymark on the Vanguard line to Buttress on the Expanse line, to serve the requirements of a large section of the country south of Swift Current, according to recent reports.

The proposal is advanced by the Manitoba Motor League and the Kenora Motor League and other interested parties that a road be constructed connecting Winnipeg with Kenora, Ont., at a link in the projected Canadian National Highway. The distance from Winnipeg to Kenora is roughly 120 miles.

Baldry, Yerburch & Hutchinson, contractors for section No. 2 of the Welland ship canal, have reopened their office at St. Catharines and are organizing for the resumption of work on this section of the canal. Alex. Grant, formerly of the Trent Valley Canal, is now taking hold of operations in his new position of chief engineer of the Welland Canal.

It is stated waterworks extension will soon be needed in Regina, Sask., and that this matter will probably be brought before the newly-elected council shortly. The probable method of increasing the water supply will be by well drilling further afield in the Boggy Creek watershed and the provision of additional storage facilities within the city limits.

Engineer G. Rogers of Assiniboia, has been instructed by the council to prepare a report regarding the placing of building regulations in certain sections of the municipality. The council has in view the introduction of a by-law restricting the type of buildings to be erected and also placing the erection of all buildings under the supervision of the municipal authorities.

No effort will be made by the city of Toronto to provide protection for the island shore until next spring. Following an inspection by Parks Commissioner Chambers and Deputy City Engineer Powell, the conclusion was reached that nothing could be done in the way of protection during the winter months. In the spring, if the funds are available, stone groins will be put in along the shore.

The elimination of level crossings on Bloor street between Lansdowne Ave. and Dundas street, Toronto, is being discussed. It is suggested that the railroad tracks crossing Bloor between these streets be depressed, so that the Toronto Railway Company's line and the Bloor street civic line may connect. Commissioner of Works Harris has already been instructed to prepare plans for a grade separation at this point.

The North American Antimony Smelting Co., Ltd., owners of the antimony mines at Lake George, York County, N.B., are completing plans for the opening of the mines and smelting works in the coming spring. The antimony ore deposits at Lake George are declared to be one of Canada's richest mineral possessions, there being no other deposit of this mineral in Canada or the United States capable of maintaining a smelter plant.

The building operations during 1919 in St. Boniface, Man., according to the estimates of the building inspection department, were as follows: The St. Boniface building inspection department reports the building operations in the cathedral city for 1918 as follows:—January, \$500; February, \$51,000; March, \$4,400; April, \$22,700; May, \$7,275; June, \$9,775; July, \$60,500; August, \$97,650; September, \$2,125; October, \$3,160; November, \$11,000; December, \$4,850; Total, \$268,905. The total in 1917 was \$155,525.

At a recent meeting in Toronto strong resolutions were adopted by the Building Trade Unions to the effect that the Government should cancel all orders-in-council and release all political prisoners, and it was decided to present petitions calling for these measures, the primary object in view to obtain the release of Charles Watson, ex-policeman, recently sentenced to three years for having prohibited literature in

his possession. It was further decided to call mass meetings of all unemployed tradesmen of the building industry every Wednesday morning to make protests against present conditions.

Personals

Hon. H. H. Wickwire, K.C., M.P.P., has been appointed as Nova Scotia's first Minister of Roads.

Mr. G. J. Lamb, former assistant city engineer of Port Arthur, Ont., is now town engineer for the Kipawa Fibre Company at that company's industrial townsite, Temiskaming, P.Q.

W. S. Harvey, who for several years was in the sewer section of the Department of Works in Toronto, and who has lately been construction engineer for Leaside Munitions, Ltd., has now been appointed engineer of sewers with the Toronto Harbor Commission.

Mr. G. H. Duggan has been appointed to the presidency of the Dominion Bridge Co., filling the vacancy created by the resignation of Mr. Phelps Johnson. Mr. Duggan has acted in the capacity of vice-president and managing director of the company for several years past.

Mr. W. H. Carter, of the Carter-Halls-Aldinger Co., president of the Winnipeg Board of Trade, recently tendered a dinner to Dr. C. N. Bell and the members of the present council of the board as a recognition of Dr. Bell's services as its secretary covering a period of thirty-two years.

Lieut. Col. Arthur Dubuc, of the 22nd French Canadian Battalion, a well-known Montreal engineer, has been awarded the Bar to the Distinguished Service Order. The official statement says that Lieut. Col. Dubuc led waves of infantry at a critical moment of the attack on an important village.

Capt. John McGregor, M.C., D.C.M., of the 22nd Mounted Rifles, First Central Ontario Regiment, has been awarded the Victoria Cross for "the most conspicuous bravery, leadership and self-sacrificing devotion to duty." Previous to enlistment Capt. McGregor followed the trade of carpenter in Victoria, B.C.

Mr. W. Walker has been appointed division engineer of the eastern lines of the Grand Trunk Railway System, in succession of Major F. L. C. Bond, recently made chief engineer of the system. Mr. Walker entered the Grand Trunk service in 1908 as assistant in the office of the engineer of Maintenance of Way, having previously been engaged in railway and dock construction in Scotland and Brazil. In 1909 he was appointed assistant engineer in the chief engineer's office, and a year later was made assistant engineer of the Ottawa division. In 1916 Mr. Walker was appointed assistant Land Commissioner and has been acting division engineer of the eastern lines since 1917.

Obituary

Mr. Julius E. Waterous, whose name is well-known to the building and construction industry as one of the founders of the Waterous Engine Works Co., Brantford, Ont., died recently at his home in that city in his seventy-fifth year. When Mr. Waterous first went to Brantford, many years ago, he became a member of the foundry firm of Von Brocklin and Waterous. Later this firm was reorganized as the Waterous Engine Works, with which Mr. Waterous was connected as mechanical manager and vice-president until he organized the Waterous Wire Nail Works in 1896. He was connected with the installation of a number of waterworks plants in various cities in Ontario and was an outstanding figure in the development of the great industry bearing his name, which is so widely known in connection with manufacturing and construction interests.

Mr. I. Feldman, of the architectural firm of Hynes, Feld-

man & Watson, Toronto, died on January 10 in his thirty-second year. Mr. Feldman, who was born in New York City, received his first architectural experience with the Decorators' Supply Co., of Chicago. Later he went to Detroit and finally came to Toronto, where he became connected with the firm in which he was partner at the time of his death. He was with the firm since 1906 and entered the partnership four years ago. Mr. Feldman was architect for quite a number of warehouses in Toronto. He was associate architect on the Allen theatre on Richmond Street, and also designed the other Allen theatres in course of erection in Toronto. He was a member of the Ontario Association of Architects and had just retired from the secretaryship of the Toronto Chapter. He was also prominent in various Hebrew societies in the city. His death was due to influenza, which he took while in Detroit, where he had gone to bring his wife and child home from a visit to that city.

Col. Robt. S. Low, manager of the firm of Bate, McMahon & Co., died on January 15 in Ottawa, following an operation which was undertaken to relieve acute blood poisoning due to an infected ear. Col. Low's name is well known throughout Canada in connection with the construction of the



Late Col. Robt. S. Low.

big military camps and the reconstruction work at Halifax. He was born in East Saginaw, Mich., in 1874, of Scotch parents. In 1886 he and his parents came to Halifax, where he commenced his business career as timekeeper in his father's office in 1887. Two years later he was appointed assistant superintendent, which position he held till 1894. The following two winters were spent in the United States, and on his return in 1896 he was made superintendent of his father's business. In 1899 he became a partner of the firm McManus, Low & McManus, and in 1900 of Low, McManus & Horne. The name of this firm was changed to the R. S. Low Contracting Co. in 1901 and continued under his direction until 1910. His partnership in the Bate, McMahon concern was formed in 1912. In August, 1914, Col. Low was appointed, by the Minister of Militia, Hon. Lieut. Col. O.C. 4 Pioneers, C.E.F.; he was made Lieut.-Col. Feb. 1, 1916, and later Honorary Colonel. Following the Halifax disaster, in December, 1917, Col. Low volunteered his services for the reconstruction without compensation and the work was supervised by him until June, 1918, when he resigned owing to pressure of work in connection with his firm's contracts.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Bridgewater, N.S.

Town Council plans construction of macadam pavement. Clerk, Jas. A. Curll.

Chesterville, Ont.

Town Council plans construction of four miles of concrete sidewalks. Clerk, Geo. Elliot.

Fredericton, N. B.

City Council plans street paving costing \$200,000 for next five years, with annual expenditure of \$40,000. Clerk, G. R. Perkins.

Hamilton, Ont.

City Council plans construction of new sewer system. Clerk, A. Kappele.

Kimberley, Ont.

Kimberley Water Co. plans extension to reservoir.

Perth, Ont.

By-law has passed for construction of granolithic walks costing \$7,000 for Municipal Council. Clerk, Jno. A. Kerr.

Portage La Prairie, Man.

Rural Municipality plans construction of road costing \$8,000. Clerk, D. McCowan.

St. Pamphile, Que.

Municipality plans construction of macadam roadway costing \$7,000. Sec.-treas., H. Jean.

St. Thomas, Ont.

Township Council plans tile drainage work. Clerk, W. C. Caughell.

Saskatoon, Sask.

City Council plans construction of pavements costing \$202,420, and storm sewer costing \$34,950. Clerk, Andrew Leslie.

City Council (Electrical Dept.) plans construction of intake well costing \$36,000.

Sherbrooke, Que.

City Council contemplates paving costing \$487,259, of which \$100,000 worth is to be done in 1919. Clerk, E. C. Gattien.

Smithville, Ont.

By-law has passed for grading and paving, and tarvia roadway will be laid in Spring costing \$4,000 for Township Council. Clerk, F. W. Roberts.

Strathroy, Ont.

Town Council plans sewer extension and construction of pavement costing \$35,000. Deputy Reeve, Mr. Hill.

Victoria, B.C.

City Council plans construction of macadam roadway in yard of Colberg Shipyard. Engineer, F. M. Preston.

Railroads, Bridges and Wharves

Hamilton, Ont.

Department of Public Works, Ottawa, plans development of harbor costing \$1,500,000, and construction of turning basin for harbor. Secretary, R. C. Desrochers, Ottawa.

Kelowna, B.C.

Department of Railways, Ottawa, plans construction of railway line from here to Kamloops. Chairman of National Railway Board, D. B. Hanna, Ottawa, Ont.

Montreal, Que.

Harbour Commrs., Ottawa, previously reported City Council in error, plans erection of bridge over St. Lawrence River. Sec.-treas., M. P. Fennell.

St. Pamphile, Que.

Municipality plans construction of iron bridge costing \$18,000. Sec.-treas., H. Jean.

Saskatoon, Sask.

City Council plans street railway extensions costing \$46,000. Engineer, Mr. Archibald.

CONTRACTS AWARDED

Portage La Prairie, Man.

Work is to start for three truss bridges for Rural Municipality: Foundations, John Gunn & Sons, Bank of Nova Scotia Bldg.; Winnipeg.

Sunbury County, N. B.

Bridge costing \$31,000 over Oromocto River for Provincial Government: General contractor, Kennebecasis Contracting Co., St. John.

Public Buildings, Churches and Schools

Alix, Alta.

Town Council plans erection of memorial hospital. Address, Mayor.

Bridgewater, N.S.

Town Council plans erection of hospital. Clerk, Jas. A. Curll.

Drumheller, Alta.

By-law has been passed for erection of \$36,000 municipal hospital. Architect, Mr. Blakey, Parliament Bldgs., Edmonton.

Guelph, Ont.

Department of Agriculture, Toronto, plans erection of dormitory in agricultural college.

Haileybury, Ont.

Town Council plans erection of fire hall costing \$10,000. Mayor, N. J. MacAulay.

Halifax, N.S.

Plans and specifications are with the secretary, S. J. Wilson, 81 Sackville St., who is receiving tenders until March 1st, for repairs to "St. Patricks" boys

school for School Board, 81 Sackville St.

Salvation Army plans erection of maternity hospital costing \$125,000. Chairman, Major Moore.

Hamilton, Ont.

Department of Public Works, Ottawa, plans erection of \$500,000 post office. Secretary, R. C. Desrochers, Ottawa.

Kemptville, Ont.

Plans are being prepared for agricultural school for Department of Agriculture, Toronto.

Lindsay, Ont.

Presbyterian Congregation plans repairs to church. Secretary, John Smith.

Montreal, Que.

E. Parrot & Sons, 260 Pine Ave. E., plans erection of public garage costing \$10,000.

Port Credit, Ont.

St. Andrew's Presbyterian Church plans erection of church. Pastor, Rev. G. R. Duncan.

St. James, Man.

Methodist Congregation plans rebuilding church which was destroyed by fire with loss of \$11,000. Pastor, Rev. T. G. Bethell.

St. Thomas, Ont.

City Council plans erection of Memorial hospital. Clerk, W. B. Doherty.

City Council plans erection of women's community building.

Tourville, Que.

Parish plans erection of church. Curate, T. Lachance.

Toronto, Ont.

The Redemptorist Order of the R. C. Church, President, Rev. Father T. J. Mulhall, 141 McCaul St., has started campaign to raise \$750,000 for erection of seminary, college and novitiate.

Danforth Park Ratepayers Ass'n. plans erection of community hall. Secretary, D. McCarthy, 418 West Lake Ave.

CONTRACTS AWARDED

Burlington, Ont.

Department of Public Works, Ottawa, has awarded contract for \$16,000 gymnasium building in military hospital to K. Connors, 31 Lamoureux St., Hamilton.

Halifax, N. S.

Glebe house costing \$8,000 for St. Joseph's Church, Russell St.; Electrical work, John Starr & Co.; heating, Longards Ltd.

Repairs to "Oxford" school costing \$13,000 for School Board, 81 Sackville St.; Plumbing, G. H. Kinsman, Cornwallis St.; heating, Longards Ltd., Hol-

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What is the Government's Intention? Unemployment is Increasing

IT is becoming more apparent every day that we must look to public works as the chief reservoir which will enable us to tide over the approaching, and in many places already existing, unemployment crisis. It is stated that in Toronto alone there are in the neighborhood of 10,000 men out of employment. This number is being added to daily by the thousands of men returning from Overseas, and if there is any further delay in starting Government construction work, as appears probable, we shall immediately be confronted with an inevitable and most serious crisis.

The statement has been made on various occasions by the Minister of Public Works and other Government representatives to the effect that it was the intention of the Government to proceed immediately with many necessary public improvements which had been shelved during the war. At that time the announcement had seemed very hopeful, but up to date we have no information as to any new Government contracts having been let, or any ground having been broken, and the months are slipping away.

What is required is immediate work all over the

country. Procrastination on the part of the Government will result in a very serious condition, a condition that can be avoided by prompt action.

Then again, our winter, so far, has been a very open one. There has been scarcely a day that construction work could not have been carried on. While we could not expect the Minister of Public Works to be advised on this score, yet we believe that the various proposed Government contracts should have been in such shape as to permit the contractors to take advantage of the exceedingly favorable building weather.

Many contractors have been keeping their organizations intact at considerable expense to themselves on the strength of the promises from Ottawa that there would soon be considerable work under way. Failure of this expected activity to materialize is resulting in increasing anxiety and discontent as well as expense.

We thoroughly appreciate the many problems and the immense amount of work piling up in the various departments at Ottawa, but in our opinion, a decision of such vital importance to the country as this is, should be made at once and go-ahead instructions issued without further loss of time. Action is wanted, immediate action—not promises.

A Home as an Investment

THERE is no time like the present. This is true of home building. The present moment is favorable to the building of homes of all classes, from those of the millionaire to those of the workingman. The object in building your own home is to secure comfort. The opportunity for home building and owning comes with the possession of surplus means which can be invested in that way. Many persons of wealth have added largely to their fortunes through the war, even after deducting the income and profits taxes. The present is a very favorable period for the use of such gains in the immediate building of new homes, so that the desired increase of comfort may be enjoyed at an early date.

Many wage earners recently earning more than ever before, have prudently laid aside a part of their earnings and have now accumulated either in Victory Bonds or in the savings banks, considerable sums with which they can begin home construction.

The War Service Gratuity authorized by the Government will furnish each soldier on discharge with a considerable sum of money. This money could be invested in no better way than in a home. Delay may result in the spending or unwise investment of this money. It is a part of wisdom to begin promptly the best form of investment for the workingman—a home for himself and his family.

Provincial Highway Assured

THAT the Ontario government will immediately ask for tenders for the construction of one hundred miles of the new Provincial highway and that on the remainder of the highway extensive preliminary work will be proceeded with during the summer, was the statement made by Hon. Finlay G. Macdormid, Minister of Public Works and Highways for the Province, at the recent annual meeting of the Ontario Motor League. It was not the intention of the Government, he said, to establish a uniform width or standard cost for the new highways. The counties are to be encouraged in carrying on an aggressive pro-

gramme in connection with the construction of market roads under their control.

The Minister read a resolution passed at a recent convention of the United Farmers' Association, calling upon the Ontario government to exercise wise judgment and protesting against the reckless expenditure of the people's money in the construction of expensive highways for the benefit of idle speed-motorists. He had entirely disagreed with this resolution because he did not believe it correctly represented the attitude of the farmers of the province towards the government's policy of road construction. There was no other association that took the same attitude in regard to the movement. It was not the intention of the government to construct expensive roadways for idle speed motorists, but to build highways to take care of the rapidly growing Province of Ontario.

Hon. Mr. Macdormid said that through the Government he is endeavoring to obtain the services of an expert road builder, who will be in full charge of the construction. The name of the appointee will probably be announced shortly.

Other speakers at the same meeting were Mr. Geo. C. Diehl, chairman of the Good Roads Board, Buffalo; Mr. Herbert W. Baker, of Albany, N. Y., secretary of the New York State Automobile Association; Col. Mulloy, of the Department of Repatriation, Ottawa; Mr. Geo. H. Gooderham, M.P.P., chairman of the Toronto-Hamilton Highway Commission. Mr. Frank Roden, the retiring president, in his presidential address, stated that the motorists proposed to ask the government to increase the speed limit five miles per hour, in cities, towns and villages, making the speed limit 25 miles in the country and 20 miles in the city.

The officers of the Ontario Motor League elected for the coming year are as follows:

President, J. J. Gibbons; vice-presidents, G. A. Hodgson, A. R. Greene, A. D. Bowlby (Windsor); secretary-treasurer, W. G. Robertson; managing editor Canadian Motors, W. B. Hastings. Board of Directors: Messrs. Frank Roden, Dr. P. E. Doolittle, G. M. MacWilliam, G. A. Hodgson, L. B. Howland, O. Hezelwood, H. Gagnier, Capt. J. P. Beaty, S. M. Kenney, F. J. Barber, W. S. Smith, J. J. Gibbons, W. T. Marlatt, F. J. Sleght, E. F. Hick, S. A. Sylvester, W. W. Digby, A. E. Chatterson, C. M. Ricketts, T. N. Phelan, M. J. Overell, W. F. Goforth, C. H. Carlisle, Arthur Hewett, A. R. Greene, F. E. Mutton, Wm. Stone, Chas. Boothe, N. R. Gooderham, J. Allan Ross, Alfred Rogers, J. E. Ganong, William Findlay, Frank M. Johnston and A. D. Bowlby; Auditor, Osler Wade.

London Builders' Exchange Annual

AT the 21st annual meeting of the London Builders' Exchange, which was the best attended and most enthusiastic in its history, all of the 1918 officers were re-elected for 1919. The list is as follows: President, Harry Hayman; 1st vice-president, L. A. Boss; 2nd vice-president, Ed. Gerry; treasurer, Thos. A. Jones; honorary secretary, Geo. S. Gould; directors: B. Noble, Geo. Hyatt, A. C. Nobbs, John Whittaker, T. R. Wright; auditors, J. R. Haslett, Geo. Mills; representatives fair board, T. A. Jones, Geo. S. Gould; annual convention, Messrs. Dennis, Boss, Gibbons, Willis, McWaine; alternates, Messrs. Martin, Hayman, Pace, Young, Banks.

The London Exchange, as pointed out by President

Hayman, has attained its majority, and while the past year has not been as good for the building industry as it might have been, it has at least been a great test of the loyalty of the members and they now look forward to the coming season of 1919 with enthusiastic optimism. The president thanked the members for the kind support they had given him and trusted that the exchange members would do their part in the great work of reconstruction in all its phases. He commented on the opening of the new London Technical School as a great cause of gratification on the part of the builders,

Stability in Prices Sought by Builders

THE building investor is seeking more assurance of stability of material prices and other construction costs before undertaking any building. This is becoming more apparent every day. When the subject of building is broached, the first question asked is: Is there any drop in prices, or what likelihood is there of prices taking a tumble?

As a result of this feeling, those interested in the industry must get together and thresh out the problems of how to insure price, stability and uniform construction costs.

The Building Trades Employers' Association of New York took a forward step last week to insure the stability of the labor situation when the board of governors adopted a resolution to the effect that "all trade agreements expiring at the end of 1918 may be renewed for a time not exceeding one year, and that trade associations shall not agree to pay a wage in excess of that now being paid, as set forth in a schedule, in any new agreement made for the year 1919. This schedule fixed the per diem rate of wages for carpenters, \$5.50; same for shops, \$5 (in all boroughs); composition roofers and waterproofers, \$4.25 (Jan. 1, 1919, \$4.75); concrete workers, laborers, \$3.00 (Jan. 1, 1919, \$4); elevator constructors, \$5.52; elevator constructors' helpers, \$3.25; house shorers, \$4.50; painters, \$5.50; plasterers, \$6.50; plasterers' laborers, \$4.50; stonecutters, \$6; woodworkers, \$22 per week, minimum.

This schedule included the resolution that "the rates of wages now being paid shall be strictly adhered to by all members of the association until the expiration of the existing trade agreement, except in the case of those existing agreements which provide for additional increases." The schedule includes:

Asbestos workers, \$5.50; helpers for same, \$4; bricklayers, \$7; laborers for same, \$4; cement masons, \$5.60; dock builders, \$5; electricians, \$6; helpers, for same, \$3; engineers, \$6.50; housesmiths (structural), \$7; housesmiths (finishers), \$6.40; marble cutters and setters, \$6; marble carvers, \$6.50; marble polishers, bed rubbers, sawyers, \$5.30; mosaic workers, (helpers), \$4; plumbers, \$6; slate and tile roofers, \$6.40 (Jan. 1, 1919, \$6.50); steamfitters \$6; helpers for same, \$3.40 (\$4 when working eight hours or less); roofers and sheet metal workers, \$5.60 (July 1, 1919, \$5.80); stone setters, \$7; tile layers, \$6; helpers for same, \$3.65.

The early construction of the C. N. R. branch line from Vernon to Kamloops will be urged upon the Federal Government by a deputation from the Okanagan District.

Toronto Builders' Exchange Holds 27th Annual Meeting

THERE was a very full attendance at the 27th annual meeting of the Toronto Builders' Exchange, held on Monday, Jan. 20th, in the Exchange rooms at 34 Victoria Street. Mr. W. E. Dillon, in his presidential address, thanked the members for their support in making the Exchange a success and bringing it back to normal activity. He pointed out the very serious way in which the war had affected them, which had necessitated moving to the present smaller quarters. However, during the past year thirty new members had been added and a few old members had been brought back into the fold. Several special meetings had been held and considerable work done. Mr. Dillon referred to the Ottawa conference and the other meetings which had been called in connection with the formation of the Association of Canadian Building and Construction Industries. He also mentioned the interviews which delegates from the Exchange had had with government ministers in regard to housing and technical education, and the interview of the joint deputation from the Sheet Metal men and the Exchange with Hon. Dr. Cody, in regard to technical education. The various phases of this question had been discussed with Dr. Cody, who had declared himself as being very pleased that their industries were taking such

tions had also held very successful dinners. Two new sections were being formed. Mr. Oakley was ready to announce a sewers and paving section, and Mr. Furnival, a roofers' section.

Refuting the statements of some who had said there was no benefit to be obtained from membership in the Exchange, Mr. Dillon said that his own firm had derived considerable benefit. The daily bulletin,



W. E. Dillon, Retiring President, Toronto Builders' Exchange



A. D. Grant, President Elect, Toronto Builders' Exchange

an interest in the problem, and had promised to have his staff go around the various workshops and ascertain the classifications in which the boys might be placed for educational purposes.

Mr. Dillon also made reference to the work done by the various sections. The masons' section had held a dinner, to which a number of outsiders had been invited, and the result was the addition of a number of new members. The plasterers' and carpenters' sec-

which had formerly been issued, listing proposed work, had been very helpful, and they had been provided with plans and specifications. The firm also had their name brought prominently before architects and builders through the exchange telephone directory, and there was the great advantage of being able to meet and discuss questions of interest to the trade. The Exchange had taken a keen interest in such questions as the Workmen's Compensation Act and the Mechanics Lien Act, and had done a great deal of work in regard to them. Particular reference was made to Mr. Gander's good work in connection with the Workmen's Compensation Act.

Mr. Dillon said the policy of the Exchange was to do all in its power to improve labor conditions. In regard to the returned soldiers he was sure the men of the trade would do their bit in re-establishing these men in civil life. Personally he had found the returned men showed the same pluck and energy in taking up industrial work again as they had shown in the trenches.

Minutes of the last annual meeting and of the special meetings held on June 12, and Nov. 19, to discuss and organize for the Ottawa conference of Canadian Building & Construction Industries, were then presented and received. The secretary-treasurer's report



A. H. Dancy, Vice-President



John Aldridge, Treasurer



David J. Davidge, Secretary

OFFICERS OF TORONTO BUILDERS' EXCHANGE, 1919

was also presented and received, showing a net gain for the year of over \$700.

Then followed the election of officers. It was the unanimous wish of the meeting that Mr. Dillon should hold office, as president, a second year, but owing to business demands, he was unable to see his way clear to do so. The rules of the meeting were suspended in order to discuss a motion by Mr. Douglas, which proposed increasing the number of men on the board of directors from five to ten. After some expression of opinion for and against, the motion was voted on and lost. The election finally resulted as follows: President, Mr. A. D. Grant; first vice-president, Mr. Walter Davidson; second vice-president, Mr. A. H. Dancy; treasurer, Jno. Aldridge; board of directors, M. John V. Gray, Mr. C. B. Jackson, of Jackson-Lewis Construction Co. Mr. J. R. Page, Mr. Geo. Stocker, and Mr. G. R. Douglas. Mr. H. Elgie, Mr. Geo. Gander and Mr. Geo. Oakley declined nomination for office on the ground that the time had come for the younger members of the Exchange to take hold of the organization.

A resolution, moved by Mr. Stocker, and seconded by Mr. Dancy, was next presented to the meeting, reading as follows:

Whereas a Dominion-wide Association of building industries has recently been organized for the purpose of dealing more effectively with the vital questions relating to the industry, than is possible through the efforts of local bodies; and

Whereas we believe our definite connection with such an association would not only very materially strengthen its position, but would react in large measure towards the broadening of our local influence, and the stimulating of our local efforts in the attainment of the various objects sought by us as an exchange,

Therefore, be it resolved:

"That the Toronto Builders' Exchange become amalgamated with the said "Association of Canadian

Building and Construction Industries" following forthwith upon its adoption of a constitution and by-laws and the granting of its government charter."

There seemed to be a majority in favor of the action proposed in this resolution, but as was pointed out by Mr. Kirby, there was not sufficient time for a proper discussion, and it was finally decided to postpone the meeting for one week. It was also hoped that in the meantime there would be some information to hand regarding the constitution of the A.C.B.C.I., particularly in regard to the finances and fees.

In regard to the coming meeting of the Provincial Builders' & Supply Association at Chatham, it was decided, on motion of Mr. Bulley, that the selection of delegates be left to the board of directors. It was also resolved, on motion of Mr. Aldridge, that the usual per capita tax be subscribed to this association for convention expenses.

On the recommendation of the Board of Directors, life memberships were conferred on Mr. John Aldridge, Mr. Jas. Wickett, Mr. W. J. Davidge, Mr. Jas. Crang and Mr. Edward Gearing.

Peterboro Trades Council Elect Officers

At a recent meeting of the Trades Council in Peterboro, Ont., the following officers were elected:

President, A. J. Bolwell; vice-president, E. Marchand; corresponding secretary, W. Stevens; financial secretary, T. Quinn; sergeant-at-arms, Donald Wires; auditors, Robt. Reid, J. Begley, M. L. Campbell; trustees, Harry Gainey, Peter McArthur, Thos. Stenton, A. J. Bolwell, T. Oglivie.

Great Britain has already set aside more than thirty million pounds for road making machinery—chiefly for Scotland. Road rollers, stone crushers, steam tractors, spreader wagons and all other equipment necessary for the construction and repair of roads, will be required, and it is expected that it will not all be supplied from within the British Isles.

Proposed Bridge Over St. Lawrence Again up for Discussion

REPRESENTATIVES of thirty South Shore municipalities, at a recent meeting held in Longueuil, P. Q., passed a strong resolution requesting the construction of a bridge across the St. Lawrence between Longueuil and Montreal. The resolution reads as follows:

"The representatives of the South Shore counties now in meeting at the City Hall of Longueuil represent respectfully to the Federal Government that in view of the end of the war a great number of industries which were engaged in war work, are now paralyzed and a great number of soldiers are coming back from the front who have need of work, as well as, the civilians who worked in war industries who have also need of immediate work.

"And in view of the fact that before the war the project of the bridge laid down by the Harbor Commission of Montreal was practically adopted and would have been carried out had it not been for the war, and, whereas, now the war is over, the Government should immediately authorize the Harbor Commission to put into execution this project in the general interest of the country, and particularly of the counties on the South Shore, and of the city of Montreal."

Moose Jaw Waterworks Report

COMMISSIONER Geo. D. Mackie, of Moose Jaw, Sask., recently issued the following report, regarding the operation of the city waterworks plant in 1918:

"The total quantity of water used in the city in the year 1918 was 234,270,000 gals. or on an average of 946,000 gallons per day, as compared with 365,285,000 gallons or an average of 1,001,000 gallons per day for the year 1917.

"The undernoted table shows monthly the average quantity of water used in the city during the years 1917 and 1918 per day. The total quantity of water used for industrial purposes for the year 1918 was 114,000,000 gallons as compared with 81,764,000 gallons for 1917, an increase over the year 1917 of 32,311,000 gallons.

Water Supply.

The average quantity of water supplied per day in each month of 1917-1918 was:

	1917	1918
	Gals.	Gals.
January	998,000	886,000
February	1,096,000	921,000
March	1,036,000	934,000
April	852,000	812,000
May	1,107,000	699,000
June	1,143,000	858,000
July	991,000	971,000
August	850,000	987,000
September	1,078,000	1,057,000
October	937,000	1,085,000
November	964,000	1,125,000
December	967,000	1,085,000

Average per day 1,001,000 946,000

"The undernoted table shows the average quantity of water used per day for industrial and domestic purposes for the years 1914 to 1918.

	Industrial Purposes Gallons.	Domestic Purposes Gallons.	Total Gallons.
1914	139,092	667,598	806,700
1915	146,961	573,000	719,961
1916	209,839	600,161	810,000
1917	224,000	777,000	1,001,000
1918	312,500	633,500	946,000

"The various sources from which the water supply was secured as compared with 1917 was as under:

	1917	1918
Caron	262,225,000	240,210,000
Snowdy Springs	70,395,000	57,395,000
Power House Gallery	32,665,000	47,665,000
Totals	365,285,000	345,270,000

Western Engineers Co-operate in Work of Reconstruction and Development

WESTERN engineers are evidently determined to play their full part in the work of reconstruction and general development. At a recent meeting of the Manitoba Branch of the E. I. C., some very important resolutions were discussed, and it is the intention to intimate to the Government that any public questions involving the expenditure of large sums of public money will receive the keenest attention of engineers as a body of public-spirited men, before passing the Federal, Provincial or Municipal authorities. There was a lengthy resolution presented urging most strongly the need for a commission or central board to deal with vital problems affecting the reconstruction period. Some of the questions discussed were: natural resources and the best methods of their development, the building of highways, the drainage problems in connection with swamp lands, the determining of the boundaries of the province, and the provision of finances to carry out work on any such projects.

The propaganda committee had prepared a resolution, which is to be presented to the Provincial Cabinet, after it has been redrafted, made more general in character and confirmed at the next meeting. The first clause taken up was a plea that lines of communication interconnecting all parts of the province, by means of highways, roads and water routes, is the first requirement in any comprehensive scheme of development, and that the provision and maintenance of these must precede the development of any or all material resources. It was also urged that a determination of the physical features of the province would contribute to systematic, orderly, logical and economical development. The meeting was agreed that the programme outlined would provide much work and thus help towards the re-establishment of the returned soldier in civil life.

Another clause emphasized the desirability of making any plan with regard to drainage or irrigation, province-wide. The resolution was also argued that the construction of highways, roads and bridges, the drainage of swamp lands, or irrigation of arid lands, and the determination of, and co-ordination of data affecting the physical features of the province should be considered as three functions of one activity tending toward the development of the natural resources of the province, and that all separate bodies now active therein should be consolidated under one common directorate which may take the form of a commission or a departmental board.

The cost of any necessary topographical surveys

should, it was urged, be borne by a general tax on all lands in the province or any other taxable element declared to be a beneficiary thereof.

It was made quite plain that the branch intends to work in co-operation with the provincial government and other bodies interested such as the Union of Manitoba Municipalities.

The meeting also discussed the question of making mining in Manitoba more attractive to the investor. It was felt that the present regulation, under order-in-council, did not give the same stability to the industry as would be the case if mineral rights were disposed of under Dominion act of parliament. In this the Institute has decided to co-operate with the Canadian Mining Institute in securing the necessary action along this line.

Thos. Adams Speaks on Housing Question

"WHEN we come to consider that the most important thing needed to build up the wealth of this country is the quality of our population, what madness it is to continue to allow the present conditions to remain without spending whatever millions of money may be necessary to get rid of at least the worst of them." This is the contention made by Mr. Thos. Adams, of the Commission of Conservation, in a recent address in Montreal on the housing question. Mr. Adams said:

"We have not in Canada accurate statistics regarding the comparative effect of good and bad housing conditions, but in England, where this has been done, it has been shown that the death rate of cities like Liverpool and Manchester is about 20 per 1,000, as against from about 8 per 1,000 in the garden cities and suburbs. A large proportion of the high death rate in the cities is due to the high death rate of infants, which is three times as high in the crowded cities as in the healthier model towns and suburbs. We have in Canada large cities, some in this province, which have a death rate higher than that of New York or London, and a great part of this consists in the loss of infants, of whom we lost many thousands every year more than we need do if we had more adequate control of housing conditions, and more care taken of the home-life of some of the poorer citizens. But in addition to the actual loss, we have those who are maimed for life as a result of defective nourishment, bad ventilation and poor homes."

Mr. Adams pointed out the connection between juvenile crime and mental defectives and housing conditions, and went on to state that on the whole, the bad sanitary conditions which were permitted before the war, was a worse problem and required more drastic action than anything that has resulted by way of shortage of houses during the war. "It is a remarkable fact that even when houses are plentiful, slum conditions persist in growing. If we succeed in the next few years in building until we have a surplus of houses, we will not solve the real housing problem, which is to raise the whole standard of housing accommodation for the working citizens."

New construction with Government aid, Mr. Adams said, is necessary to relieve the present pressure, but it is chiefly required as an object lesson to show how standards can and should be improved. But new houses should not be erected to compete with the present low standards and simultaneously with build-

ing model homes, we should insist on improving those which are already built.

"The land question is at the root of the housing problem. The dwelling consists of the site, the planning and development of the land to make it adaptable for housing purposes, and the building. We need to give proper attention to all three matters. Town planning has regard to the site and its development, and to the connection between the dwelling and a factory or other places of employment."

Mr. Adams also pointed out the relation between labor unrest and housing conditions. Higher standards, he said, would indirectly produce higher wages. They would help to secure more durable construction and save large sums, equivalent to many millions in Canada in fire waste and in the cost of fire prevention.

National Research Institute Needed in Canada

SPEAKING before the Engineers' Club, Toronto, last week, Dr. A. B. Macallum stated that he hoped for cabinet action very shortly on his recommendation to the government that a National Research Institute for Canada be established. Such measures, he believed, were necessary if Canada was to keep abreast of economic progress. Canada's debt had quadrupled during the war, but its people were no wealthier than they were in 1914, and to bear the load they must stimulate production along the lines of agriculture, mining and the products of the forest and the factory.

Dr. Macallum also urged that the resources of the Canadian colleges should be increased to allow research work to be more or less a part of the duty of the teachers. "How those resources can be so increased is another problem. But only by such assistance can the universities do their duty to their country. It is a question which must be discussed at an early date because the need for scientific research is urgent. The ability of a nation to carry a big debt depends to a large extent on industry."

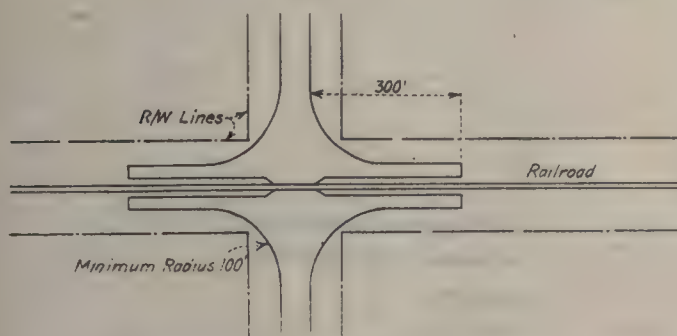
The speaker mentioned various fields of research which had been aided by his Council, such as the possibilities of production of commercial coal in Alberta, the value of the tar sands in the northern part of the same Province, rust-resisting wheat, and the commercial possibilities of producing alcohol from by-products of the pulp mills.

Provincial Builders and Supply Convention

The seventh annual meeting of the Provincial Builders and Supply Association will be held in the city of Chatham on Feb. 11, 12, 13, 1919. Mr. E. R. Dennis, of London, gives a paper on "Is a Safety First Inspector necessary for the Building Trades?" Mr. Norton, of Sarnia, gives a paper on "The Advantages of Steel Construction," and we expect others. Subjects to come before the convention of discussion are: (1) The Housing Problem; (2) The Bringing in of Outside Contractors, such as Paving Contractors, Sewer Contractors, etc.; (3) The proposed Dominion Exchange and the Benefits Accruing from the Same; (4) Legislation affecting the Lien Law; (5) Legislation Affecting the Compensation Act; (6) Better Apprenticeship and General Help from our Technical Schools. Convention opens 2.00 p.m., Feb. 11, 1919. A. Tomlinson, president; T. R. Wright, sec.-treas.

Good Suggestion for Grade Crossing

A USEFUL suggestion has been offered by Rodman Wiley, State Commissioner of Kentucky Public Roads, regarding safety at grade crossings. He suggests that it would be well to build a road parallel to the railroad track for a distance of perhaps 300 ft. each side of the main road, and, in all probability, this should be on the railroad company's right-of-way. The surface of the road should be at the same elevation as the top of the rails. In case a man saw he could not clear the track, or in other words, that he was caught, he could turn, either



Plan suggested to increase safety at grade crossings

to the right or left, off the main highway and run his car parallel to the track and prevent a collision.

Of course, such things as electric lights, electric bells, etc., should be used in all cases because they always serve as a good warning.

Important crossings should be well paved, the paving to be level with the top of the rails so as to prevent a man killing his engine on the track; also to save the wear and tear on vehicles.

Advantages of Steel in Building Construction

A N OUTSTANDING advantage of manufacture for steelwork construction in buildings is that it is quite independent of local conditions. The structural parts are almost always manufactured in districts where materials and labor are economically obtainable, so that they may be transported to the site as finished articles in convenient parts, merely requiring assembly and erection into position. As only the finished article is carried, this mode of construction has a further advantage when compared with structures where gross quantities of materials have to be considered, involving the transport of the waste as well as finished materials.

It is generally admitted that for tall buildings, in which maximum floor spaces are required, steel construction is the only available method; while in buildings of all descriptions the internal rooms may be modified as often as desired without detriment to the main structure.

For the workshop type of building, requiring long walls, which walls lack the stiffening effect and support of the cross walls found in ordinary buildings, a considerable saving in brickwork may be obtained by adopting stanchions at intervals.

The outside walls of a typical workshop building are 300 feet long, 34 feet high, and are only 9 inches thick. These walls are stiffened by stanchions of 12 in. by 6 in. of 44 lb. section, being fixed at 11 ft. centres.

In similar cases within wide limits, no considera-

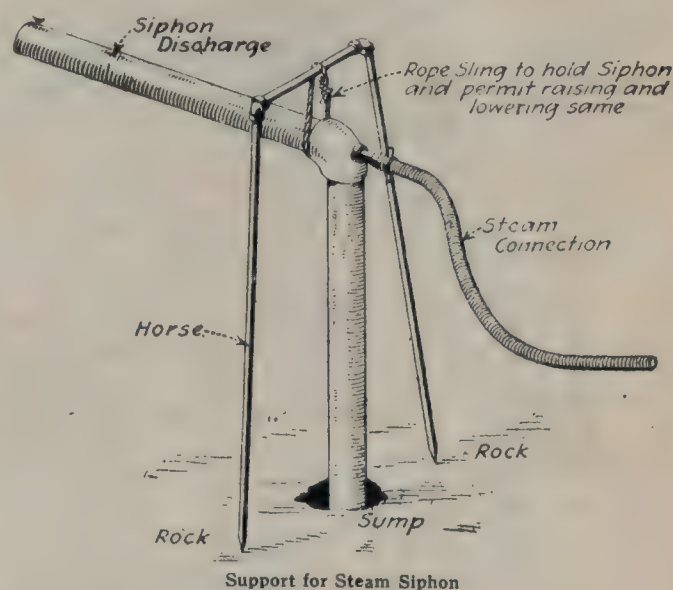
tion need be given to the height of the walls, as the centres of stanchions can be taken for the height when using wall formulae. Had an entirely brick construction been adopted in the instance cited, the lack of steel construction would have necessitated a thickness of 18 inches at the bottom of the wall.

In countries subject to earthquake shocks and districts in which subsidences occur, steel construction is undoubtedly better than any other type. It may be that if settlements are uneven the walls will crack and appear unsightly, but if due consideration is given to the beam attachments to stanchions, there is no fear of a general collapse, and only under very grave disturbances need even a local failure be looked for. Further, steel structures are certainly free from the stresses at the beam connections to stanchions which would inevitably occur from uneven settlement in a building of a continuous type.

In buildings subject to "hammering" action, such as paint manufacturing mills, printing works, oil cake mills, etc., it will be found that steel construction offers a ready and easy solution to almost all the difficulties. —J. Whitehouse in Steel Structures.

Simple Horse to Support Steam Siphon

For holding steam siphons on rock foundation the horse shown in the accompanying sketch has been successfully used. G. W. McAlpin, in Engineering News-Record, describes the construction as follows: It is made of two pieces of 1½-in. pipe pointed at the bottom to hold firmly on the rock, and connected at the



top by elbows and an 8-in. nipple. The siphon is suspended between the legs of the horse by a rope passing over the nipple. This permits the raising or the lowering of the siphon, as desired. By resting the discharge pipe of the siphon on a discharge chute or other convenient rest, balance is obtained.

In our last issue in the item regarding the nominations for the Montreal branch of the Association of Canadian Building and Construction Industries, it was omitted to mention the representatives nominated by the sub-contractors section, who are as follows: Messrs. F. B. Locker, J. P. O'Shea, John Watson, I. Crepeau and F. J. Parsons.

Statistical Analysis of the Central Electrical Station Situation of Canada

(From our Special Ottawa Correspondent)

Electrical energy provides an ideal source of power for practically all classes of manufacturing, for the operation of street railways, for the operation of mines, for municipal and domestic lighting, and for innumerable other activities. Its use in these fields is developing with remarkable rapidity. Other fields, such as the electrification of steam railroads, the smelting of ores and the expansion and increasing scope of electro-chemical and electro-metallurgical industries, offer vast scope for future development. The growth of the central station industry in Canada has been rapid, particularly during recent years. The larger electrical systems, both commercial and publicly owned, have been widely extended from year to year, opening up new territory in the electrical distribution field.

In order to properly measure the scope of the industry and to gauge its importance to commercial and industrial interests, the Dominion Water Power Branch of the Department of the Interior, in co-operation with the Dominion Bureau of Statistics of the Department of Trade and Commerce, has had under way during the past year, an exhaustive analysis of the central electric stations of the Dominion. The analysis of the statistics collected has been completed within the past few days. As some time must elapse before the complete report can be published and distributed, a brief synopsis of the statistical data has been prepared.

The report consists essentially of two sections: the first comprising the introduction and an analysis of the statistics, the second forming a comprehensive directory of the central

station industry covering concisely and systematically the principal features of the commercial and publicly owned systems and stations in operation throughout the Dominion.

4th.—Making available to those interested the locations where blocks of electrical energy are for sale, the prices at which this power is obtainable and the transportation facilities available in the vicinity.

In considering the statistics which are summarized hereunder, it should be borne in mind that the figures have re-

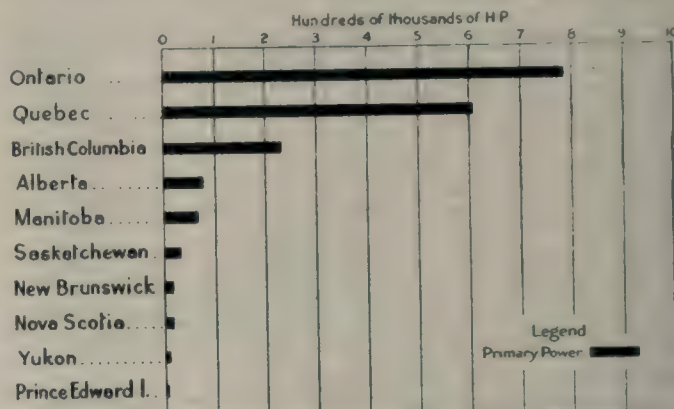


Fig. 2—Central Stations—Total primary power by provinces, 1917

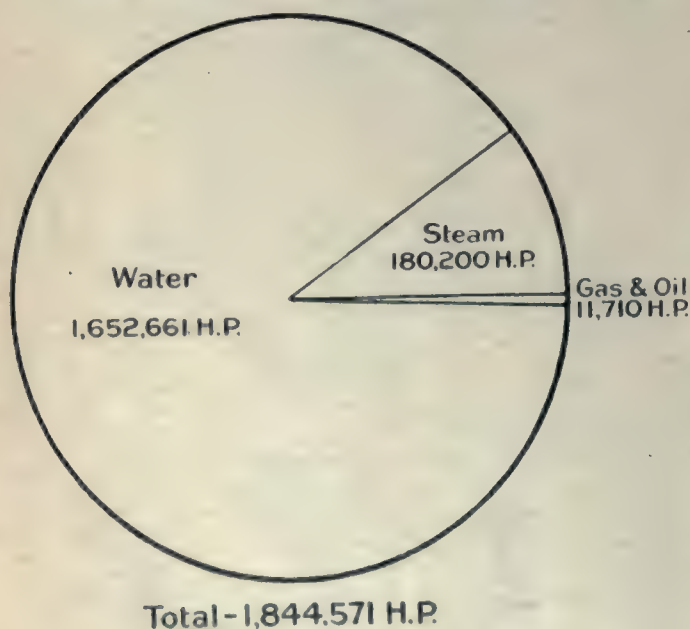


Fig. 1—Central Stations—Character of Power, 1917

electric stations of the Dominion. The purpose lying behind the compilation of the data is four fold.

- 1st.—A stock taking of Canada's present central station facilities with provision for expansion.
- 2nd.—An analysis of the statistical data collected, for the purpose of noting the characteristics and trend of the industry.
- 3rd.—The preparation of a complete directory of the central

ference solely to central electric stations, that is, to stations which are engaged in the distribution and sale of electrical energy. Where central stations are interwoven with other activities, such as the operation of electric railways, of mines, of pulp mills or of other industrial enterprises, the central station equipment, capitalization and other statistical data secured has been wholly diversified from the allied industry. This line of severance has been drawn through the entire statistical analysis. Central stations purchasing power in bulk for purposes of re-sale are included in the financial and staff statistics.

A summary of the statistics is presented in Table 1, which analyzes the outstanding features disclosed by the census returns, and shows the relationship between commercial and municipal or publicly owned stations.

The total number of central electric stations recorded is 666, of which 323 are commercial stations and 343 are municipal. Examination of the figures however shows that the excess in municipal stations is attributable to the non-generating station. Of the stations with generating equipment, 296 are commercial and 174 are municipal. Of the stations without generating equipment 27 are commercial stations and 169 are municipal. The Hydro-Electric Power System of Ontario is largely responsible for the large proportion of municipal stations purchasing power in bulk.

The outstanding features of the statistics are covered in the succeeding tables.

Power Equipment Installed.

Table 2 summarizes by provinces the number, kind and horse power of the primary power machines installed in central electric stations on January 1st, 1918. The primary power totals 1,844,571 h.p., of which 78.3 per cent. or 1,444,314 h.p.,

is installed in commercial stations and 21.7 per cent. or 400,257 h.p., in municipal stations. Of the total primary horse power installed 1,652,661 h.p. is derived from water, 180,200 from steam, and 11,710 from gas and oil. From the above figures it will be noted the 89.6 per cent. of the entire primary power in central stations in Canada is derived from water.

Power Equipment per Capita.

Table 3, showing the relation of the primary power installation to the population by provinces, affords an interest-

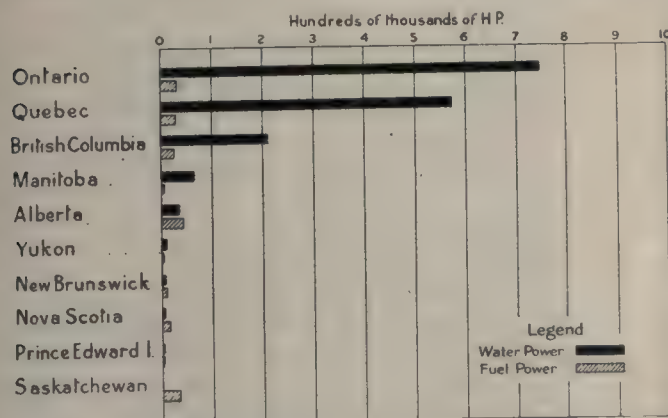


Fig. 3—Central Stations—Water vs. fuel power by provinces, 1917

ing basis for comparison and analysis. The total primary power installed in central electric stations throughout the Dominion averages 221 h.p. per thousand population. Yukon averages the highest with 1,206 h.p. per thousand population, British Columbia coming next with 376 per thousand, Ontario, with 286 per thousand; Quebec, 271 per thousand; Manitoba, 118 per thousand; New Brunswick, 49 per thousand; Nova Scotia, 34 per thousand; and Prince Edward Island, 13 per thousand population. Population by provinces is the only feasible basis available for making a per capita analysis of the central station industry. The occupation of the population, and its varied density in different localities have a direct bearing on the market for electrical power, and consideration of these phases will assist in explaining the above variations in the per capita development.

Hydro-Electric Power and Central Station Industry.

One of the most important features disclosed as a result of the statistics (see Table 2) is the outstanding position

which water power takes in the central station field. Out of a total installed primary capacity of 1,844,571 h.p., 1,652,661 or practically 90 per cent., is derived from water. This figure is indicative of the extent and availability of the water power resources of the Dominion and of the remarkable degree to

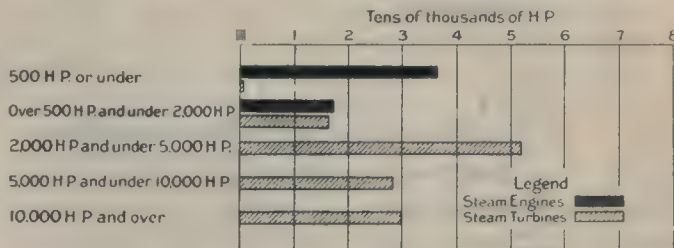


Fig. 4—Central Stations—Steam engines and steam turbines by horse power capacity of units, 1917

which their adaptability for central electric station work has been appreciated in principle and realized in practice. The vast water power resources of the Dominion, the ready adaptability of hydro power to the production of electrical energy and the increasing extent and scope of economical electrical transmission, form an industrial asset which probably more than any other will ensure a full measure of future prosperity.

The Yukon develops 97.4 per cent. of its primary central energy from water. Ontario develops 95.7 per cent. from water, indicating markedly the commercial adaptability of water power for central station work, even where in com-

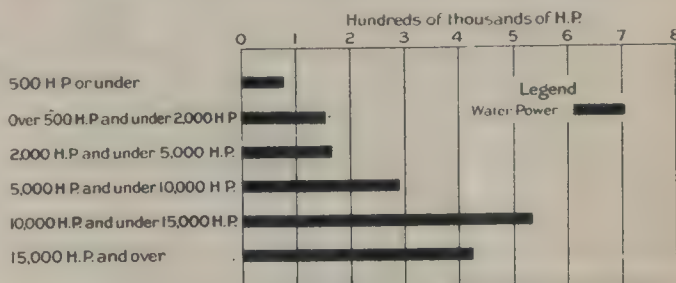


Fig. 5—Central Stations—Water wheels and turbines by horse power of units, 1917

petition with convenient and reasonably cheap coal supplies. Manitoba develops 95.2 per cent. of its central station energy from water, Quebec 94.9 per cent., and British Columbia 89.8 per cent. Alberta develops 43.2 per cent. from water, although

Table 1.—Central Electric Stations:—Summary of Principal Features, 1917

	Total	Commercial stations	Municipal stations	Percent of total. Commercial	Municipal
1	2	3	4	5	6
Number of Stations	666	323	343	48.5	51.5
With generating equipment	470	296	174	63.0	37.0
Without generating equipment	196	27	169	13.8	86.2
Total revenue from the sale of power	\$ 44,536,848	\$ 29,135,399	\$ 15,401,449	65.4	34.6
For lighting purposes	\$ 18,403,639	\$ 9,610,835	\$ 8,792,804	52.2	47.8
For all other purposes	\$ 26,133,209	\$ 19,524,564	\$ 6,608,645	74.7	25.3
Total capital invested	\$356,004,168	\$282,818,495	\$ 73,185,673	79.5	20.5
Total number of people employed	8,847	5,135	3,712	58.0	42.0
Total salaries and wages	\$ 7,777,715	\$ 4,290,505	\$ 3,487,210	55.2	44.8
Total horse power	1,844,571	1,444,314	400,257	78.3	21.7
(1) Steam Engines and Steam Turbines:					
Number	251	133	118	53.0	47.0
Horse power	180,200	117,452	62,748	65.2	34.8
(2) Water Wheels and Turbines:					
Number	619	456	163	73.7	26.3
Horse power	1,652,661	1,322,852	329,809	80.0	20.0
(3) Gas and Oil Engines:					
Number	113	52	61	46.0	54.0
Horse power	11,710	4,010	7,700	34.2	65.8
Electrical Generators:					
Number	943	627	316	66.5	33.5
Kv.a. capacity	1,387,521	1,086,546	300,975	78.3	21.7

Table 3.—Central Electric Stations:—Relation of Leading Items to Population by Provinces, 1917

Division	Population	Number of stations			Total horse power Amount	Primary power H.P. per 1000 population	Water wheel or turbine horse power Amount	Water wheel or turbine horse power H.P. per 1000 population	K.V.A. capacity of generators	
		Total	Com- mercial	Municipal					Amount	K.V.A. per 1000 popula- tion
1	2	3	4	5	6	7	8	9	10	11
Alberta	521,852	45	23	22	75,417	145	32,580	63	52,266	100
British Columbia	615,680	28	12	16	232,648	378	209,025	340	152,743	248
Manitoba	572,200	48	27	21	67,337	118	64,100	112	45,904	80
New Brunswick	364,375	24	15	9	17,733	49	6,878	19	12,757	35
Nova Scotia	511,829	36	23	13	17,444	34	3,354	7	14,489	28
Ontario	2,741,691	302	98	204	784,665	286	751,003	274	604,024	220
Prince Edward Is.	93,728	6	6	...	1,226	13	170	2	1,118	12
Quebec	2,239,276	122	96	26	606,082	271	575,551	257	471,969	211
Saskatchewan	673,945	52	20	32	31,759	47	.....	...	26,089	39
Yukon	8,512	3	3	...	10,260	1206	10,000	1176	6,162	724
Canada	8,343,088	886	323	563	1,844,571	221	1,652,661	198	1,387,521	166

with salaries aggregating \$4,290,505, and 3,712 in municipal stations with salaries totalling \$3,487,210. The total number of employees throughout the Dominion averages 4.8 per thousand installed primary horse power. The total salaries and wages paid average \$4.22 per annum per installed primary horse power. Reference to the salaries and wages per installed power capacity discloses the fact that those provinces in which are located extensive transmission systems of large central station systems, show a low salary and wage bill per installed horse power capacity. These extensive systems are in all cases founded upon water power installation. On the other hand in those provinces where central station industry is wholly or largely confined to individual stations for local purposes, the unit salaries and wages cost per installed capacity is high.

Financial Statistics.

A few of the outstanding financial features of the industry are set out in Table 5. The capital actually invested in central electric station industry totals \$356,004,168, of which 79.5 per cent. is invested in commercial stations and 20.5 per cent. in municipal or publicly owned stations.

The capital indirectly dependent upon electrical energy is enormous. No attempt has been made to go into this phase in this report. As showing the general dependability of the modern community upon electrical energy, reference might be made to the city of Winnipeg. According to a very careful and complete analysis made by the Dominion Water Power Branch in 1915 of the interests in Winnipeg which were to a greater or less degree dependent upon hydro-electric power derived from the Winnipeg river, it was shown that

capital was involved to the extent of \$169,260,963, and this on a power installation of only 55,400 h.p. The total central station power installed in the Dominion is 1,844,571 h.p.

The total revenue received from the sale of electrical energy in 1917 was \$44,536,848, of which \$29,135,399 was secured by commercial and \$15,401,449 by municipal plants.

In securing the statistics concerning capital, the actual cash investment in the central station activities was called for, apart from the consideration of stock and bond issues. The resulting figures are therefore of particular interest as a basis for determining the investment cost per horse power installed.

The figures indicate that the actual average cost per installed horse power for the Dominion is \$193. This cost includes all capital invested in construction and equipment of hydraulic works, power stations, transmission and distribution systems; real estate; cash on hand; current assets; supplies, and all other similar items.

Capital Invested in Hydro Power Central Stations.

Of special interest are the figures relating to the capital invested in hydro power central stations. The average capital cost per installed horse power for the Dominion is \$188. Referring to the table, the investment per turbine horse power in Alberta appears remarkably low. This is partially explained by the fact that in the analysis the distribution system in the city of Calgary is not charged to the hydraulic developments serving the city.

Of special interest, too, is the actual cost of construction of hydro-electric power stations per installed horse power. Omitting all real estate, transmission and distribution equip-

Table 4.—Central Electric Stations:—Total Number of Employees, and Salaries and Wages per Primary Horse-power Installed, and According to Class of Station

Division	Total primary horse-power installed	Salaries, employees and wage earners		Salaries and wages		Commercial stations		Municipal Stations	
		Total number	Per 1000 H.P. installed	Total	Per H.P. installed	Total em- ployees	Total salaries and wages	Total em- ployees	Total salaries and wages
1	2	3	4	5	6	7	8	9	10
Alberta	75,417	438	5.8	\$ 458,423	\$ 6.08	156	\$ 152,652	282	\$ 305,771
British Columbia	232,648	453	2.0	\$ 496,081	\$ 2.13	310	\$ 357,488	143	\$ 138,593
Manitoba	67,337	405	6.0	\$ 433,262	\$ 6.44	79	\$ 66,669	326	\$ 366,593
New Brunswick	17,733	215	12.1	\$ 155,164	\$ 8.75	178	\$ 125,945	37	\$ 29,219
Nova Scotia	17,444	288	16.5	\$ 227,874	\$13.07	235	\$ 193,314	53	\$ 34,560
Ontario	784,665	4,147	5.3	\$4,063,060	\$ 5.18	1,777	\$1,920,659	2,370	\$2,142,401
Prince Edward Isl.	1,226	23	18.8	\$ 17,402	\$14.19	23	\$ 17,402	.....	.....
Quebec	606,082	2,476	4.1	\$1,514,186	\$ 2.50	2,301	\$1,361,153	175	\$ 153,033
Saskatchewan	31,759	363	11.4	\$ 348,952	\$10.98	37	\$ 31,912	326	\$ 317,040
Yukon	10,260	39	3.8	\$ 63,311	\$ 6.17	39	\$ 63,311	.....	.....
Canada	1,844,571	8,847	4.8	\$7,777,715	\$ 4.22	5,135	\$4,290,505	3,712	\$3,487,210

Table 5.—Central Electric Stations:—Capital Invested in Central Station Industry Per Primary Horse-power Installed and According to Class of Stations—and Capital Invested in Hydro Power Central Stations

1	In All Central Electric Stations					In Hydro Power Central Electric Stations		
	Total primary horse power	Amount	Total Capital Invested Per primary horse power	Total in commercial stations	Total in municipal stations	Total turbine horse power	Total Capital Invested	Per turbine horse power
2	3	4	5	6	7	8	9	
Alberta	75,417	\$ 11,102,620	\$147	\$ 5,634,479	\$ 5,468,141	32,580	\$ 2,293,537	\$ 70
British Columbia ..	232,648	\$ 43,548,492	\$187	\$ 41,255,719	\$ 2,292,773	209,025	\$ 41,045,100	\$196
Manitoba	67,337	\$ 12,078,173	\$179	\$ 3,460,220	\$ 8,617,953	64,100	\$ 11,493,274	\$179
New Brunswick ..	17,733	\$ 3,443,848	\$194	\$ 2,941,569	\$ 502,279	6,878	\$ 1,315,723	\$191
Nova Scotia	17,444	\$ 3,376,405	\$194	\$ 2,776,101	\$ 600,304	3,354	\$ 686,705	\$205
Ontario	784,665	\$142,777,379	\$182	\$ 96,538,585	\$46,238,794	751,003	\$129,342,065	\$172
Prince Edward Is.	1,226	\$ 211,900	\$173	\$ 211,900	.....	170	\$ 48,400	\$285
Quebec	606,082	\$130,213,470	\$215	\$126,080,992	\$ 4,132,478	575,551	\$120,516,166	\$209
Saskatchewan .. .	31,759	\$ 5,590,515	\$176	\$ 257,564	\$ 5,332,951	.....	.....	.....
Yukon	10,260	\$ 3,661,366	\$357	\$ 3,661,366	.....	10,000	\$ 3,363,688	\$336
Canada	1,844,571	\$356,004,168	\$193	\$282,818,495	\$73,185,673	1,652,661	\$310,104,658	\$188

ment, seventy representative hydro-electric stations throughout the Dominion with an aggregate turbine installation of 745,797 h.p., and a total construction cost of \$50,740,468 show an average cost of \$69.11 per installed turbine horse power. This figure in brief represents the average capital cost of construction at the power site and is of considerable interest to engineers.

Fig. 7 presents by provinces the capital invested in water and fuel power central electric stations.

A comparison of the central station statistics of Canada with similar figures in the United States would be of interest. Unfortunately the 1917 census returns of the United States will not be ready for publication for several months. While

it is scarcely fair to compare our 1917 returns with the 1912 returns in the United States the figures may be instructive. The proportion of central station power derived from water in Canada is practically 90 per cent. In the United States in 1912 the hydro power portion was 30 per cent. of the total. The water power used in central station work in Canada averages 198 installed horse power per thousand population. In the United States in 1912 the similar figure was 24.7 h.p. per thousand population.

While the ratios in the United States have undoubtedly very materially increased during the past five years, there is little doubt but that the ratios for the Dominion are still substantially in advance of those in the United States.

Royal Architectural Institute of Canada Hold Annual Meeting in Montreal

MEMBERS of the Royal Architectural Institute of Canada held their eleventh annual meeting at the Arts Club, Montreal, on January 17 and 18. The meetings were exceptionally well attended; the principal business was on the 17th, when there were three sessions. The opening one was devoted to business matters, the one in the afternoon to addresses on architectural subjects; while in the evening, (which was a joint meeting with the Province of Quebec Association of Architects), the subject of town planning was discussed.

The rooms of the Arts Club were used for the exhibition of a large number of drawings by the members of the Institute. The drawings were principally perspectives of Canadian buildings. The exhibitors were as follows:

Toronto.—Burke, Horwood & White, 2 drawings; Wickson and Gregg, 4; Darling & Pearson, 6; Langley & Howland, 1; C. B. Cleveland, 1; Geo. W. Gouinlock, 1; Chapman & McGiffin, 1; Sharp & Brown, 1; Charles S. Cobb, 2; Shepard & Calvin, 4; Toronto Civic Guild, 2.

Montreal.—Brown & Vallance, 3; Hutchison, Wood & Miller, 2; John S. Archibald, 5; Phillip J. Turner, 1; D. H. MacFarlane, 1; L. A. Amos, 2; Ramsay Traquair, 1; Geo. W. Wood, 1; Hugh G. Jones, 8; Ross & Macdonald and M. G. Jones, 2; Ed. & W. S. Maxwell, 4; Septimus Warwick, 3; Herbert Raine, 3 etchings.

Bank of Montreal, 1 picture by Jules Guerin, value \$1,500, loaned by the Bank. Anonymous drawings, 4.

The morning session was opened with an address by Mr. G. A. Monette, president of the Province of Quebec Association of Architects, who welcomed the members and spoke of the part that the architectural profession had taken in the war. He also referred in an optimistic way to future prospects for the profession.

Mr. J. P. Ouellet, the president of the Institute, who presided, replied. He pointed out that owing to the war, the Institute has not been able to carry out all of the work that had been planned. Since the last annual meeting at Ottawa. The Architectural Institute of B. C. had affiliated with the Institute, thus forming an unity of provincial associations from the Pacific to the Maritime Provinces. These last provinces had not yet been formally united to the Institute, but the preliminaries had been made out for their affiliation in the near future. The Council had drawn the attention of the Federal Government to the awkward position, in which Canadian architects were placed by the Federal statutes with regard to their neighbors on the other side of the boundary line, in connection with facilities given to foreign architects to practice their profession in Canada to the detriment of Canadian architects. Jointly with the Civil Engineers, the Institute had prepared a memorial to be presented to the Government in order to draw the attention of the authorities to the undesirable position in which these professions were placed. They resented this condition all the more owing to the difficult circumstances that Canada had gone through.

The president went on to point out that Canadians had incontestably proved their abilities in every sphere of action. While Canadian universities and scientific schools had developed men of great ability, unfortunately the country had not benefited as it should, owing to the lack of encouragement, and to the recognition by strangers of the ability of Canadians, who had thus been drawn away from the country. The Council favored the establishment by the Federal Government of a Canadian Institute of Arts and Sciences, and also a national laboratory to make an official classification of the building and other materials of Canada. The fact could not be ignored any longer that Canada needed more than ever a bureau of this kind in this period of world building. The Institute took legitimate pride in the fact that nearly one-fifth of the total number of its members had gone beyond seas in different capacities, some of whom had laid down their lives as the price of their patriotism.

Mr. A. Chausse, the honorary secretary, submitted the annual report. This gave a resume of the proceedings of the year, and of the action taken on association and public matters, it being stated that the Council had protested against the Dominion Government's action in having started the erection of a government office building on O'Connor Street, in the city of Ottawa, in direct opposition to the advice given them by the Federal Plan Commission.

Mr. A. F. Wickson brought up the question as to the hardship of firms who had to pay additional fees when practicing in a province where they did not reside. Messrs. Brown, Maxwell, MacDonald and Hynes took part in the discussion, the general idea being that such fees were only reasonable.

A memorial to the late Mr. Edmund Burke, adopted by the Toronto Chapter of the Ontario Association of Architects was read, and was also adopted by the meeting.

Mr. J. P. Hynes discussed at considerable length, memorialising the Federal Government on the question of the employment of alien architects, and the lack of recognition of architects by the Dominion Government. He explained that in 1917 two committees representative of the manufacturers, architects, contractors and engineers, were appointed in Toronto to consider the presentation of memorials on the subjects of employing outside firms for Government work, etc. A memorial was prepared, but as it did not quite fit in with the views of the Manufacturers' Association, it was held over, although the contractors presented their memorial. As the Government resigned, the matter was left in abeyance, and he suggested that it should be again taken up. Mr. Hynes read the proposed memorial, which he said might be used as a basis for a new one. The memorial stated that the grievance complained of was due to the unfortunate belief on the part of a large portion of the business community of Canada that the ability of the Canadians was inferior to that of their neighbors, and it was even more unfortunate that there had been too much evidence that this opinion had also been held by several Governments in Canada. The memorial strenuously denied that there was any ground for this belief. The efforts of the architects to make their profession one worthy of the country's recognition had not been appreciated by the Government or the public at large, and it was felt that until the Federal Government gave a national status to the profession, it would always be handicapped in its efforts to render service to the community and to itself. There was a Customs tariff which imposed a duty on plans imported into this country of 22½ per cent. (plus a war tax of 6½ per cent.) on one per cent of the cost of a building. This was practically useless as a protective measure; It was easily avoided and frequently evaded. The memorial also complained of the alien labor law. The U. S. permitted an alien architect or engineer properly accredited to practice personally in that country, but absolutely refused to allow him to

transfer his organization to that country. In Canada on the contrary, temporary offices were established by outside practitioners, and the principals did not personally conduct their operations.

It was suggested that the Federal Government should give national recognition, status and patronage to all activities developing the manhood and brain power of Canada, and also establish national standards for all products of Canada of such a high degree as to command the recognition and respect of the world. To this end a Canadian National Institute of Art and Science should be adopted, together with a Canadian National Department of Standards. Equally important as the definite structural standards in Canada was the provision of adequate facilities for obtaining unbiased conclusions as to the quality of the materials. Under existing conditions, architects, builders and municipal officials had necessarily to accept the bare statements of the manufacturers as to the relative value of the majority of new materials and devices. When formulating municipal building laws, those in charge of the work were persistently besieged by representatives of various products, each with convincing testimony that his particular material should be given preference, or, at least, recognition. In the confusion caused by a multiplicity of conflicting data, requirements were more framed and interpreted to favor good salesmanship than in accordance with experience.

Owing to the difficulty of conducting adequate tests of materials in Canada, it was rarely possible to include requirements respecting quality in building specifications. To mention a particular brand of cement or plaster, for instance, might exclude the best on the market and to simply specify "plaster" might admit the poorest. Often an effort was made to duplicate material once found satisfactory by prescribing a specific brand and adding the words "or equal"—a recourse which was absurd, since, without definite standards or adequate testing facilities, comparison was impracticable.

Messrs. J. Venne, Rielly, Hynes, Maxwell and Ames took part in the discussion, generally supporting such a memorial, particularly in the direction of employing Canadian architects. Mr. Hynes stated, however, it had been difficult for effective action to be taken as architects were not agreed upon any common ground, and until that was done, they could not expect recognition.

The matter was left to the Council to deal with.

In the afternoon Mr. Claude Bragdon, of Rochester, N. Y., was the principal speaker. His subject was "Architecture and the Future," and was dealt with from the purely idealistic point of view, Mr. Bragdon picturing possible developments if the subject were dealt with from an imaginative point. Architecture, he said, was the expression of consciousness. It was divided into two classifications, organic and arranged. Architecture reflected the feelings of the people, and he foresaw in the architecture of the future the expression of the brotherhood of man, which has followed the comradeship of the camp. The most perfect organic architecture was that of the eleventh and thirteenth centuries, when the religious feelings, as expressed through one all-embracing church, found expression in those great cathedrals that were erected. It was the natural thing then to give vent to feelings by the building of a religious edifice. Following that period of art had come the renaissance, followed by the present form. It was to be expected now that the organic would come again, and it would represent the spirit of brotherhood, the new religion of humanity.

He felt that we were already feeling the breath of that spirit of new religion, and which was causing some people to look with misgiving at what they called irreligion, but such critics had lost the spirit of the time. "Because," said Mr. Bragden, "it does not demonstrate itself in the regular

channels of the churches, it does not mean that man is not religious, that God is not speaking to men, but merely that God is speaking to men in another way. I will make bold to say that the real essential trouble between returning soldiers and the Y. M. C. A. is the failure to see that the soldiers are getting their religion through other channels than the Church, and it is real religion and vital religion, and does not hinge on the price of cigarettes. It is something that cannot be brought out in investigation. The men who have faced death and lost their comrades are getting some spiritual consolation by which they do not need a creed or a book interposed between them and God. If so, we will have an organic architecture expressed by people who are not its slaves, but its subjects.

"Architecture of the future will and must be democratic, and people will rule, and if we as architects fail to make the people our clients, we shall have failed. You will find that they will make wonderful clients. Have we given them beauty? No. They respond to beauty; they cannot help doing so; it is automatic with them."

The trend to-day was to have more light, continued Mr. Bragdon. It meant that glass would be used more than formerly, and wonderful things could be done with glass. The "pepper-box" would not be built. There would be great buildings with great domes of glass, and only recently there had been discovered a glass which would admit light and hold out heat. The speaker emphasized the need for light. Looking over New York and seeing the endless number of roofs of stone and wood and gravel, he wondered why people should not live up on the roofs in the light instead of in dark places. Many hotels had already seized the idea. He did not see why roadways and streets should not have light. Such problems had been worked out by civic planning people. There could be blocks of high buildings alternating with blocks or low buildings, terraces, etc. The cities themselves were cancers. With rapid systems of transportation, why should they be more than places to do business in, to have a good time in, and to meet each other, while the people lived outside with the fields and forests and streams, going back each day refreshed? The rich man did that to-day. The speaker also referred to the wonderful possibilities of artificial light, and believed if it had been at the disposition of the architects of old, great things would have been accomplished with it. With a system of architecture such as he foresaw the heart would be filled with joy, the eye begin to grow critical and trained, as is the ear to music.

Mr. Ramsay Traquair, Professor of Architecture, McGill University said architecture had always been, and was to-day, symbolic of the civilization of the time. We were doing to-day exactly what had been done before. The main activities of life to-day were commerce and industry, and our great buildings showed it. There was no more impressive sight to him than the corner of King and Yonge Streets, in Toronto, where were skyscrapers. That was real architecture, and so was the Woolworth building. He believed the latter was the representative of the ancient cathedral. It was built with conviction, as was the ancient cathedral.

In the discussion which followed, Mr. J. Archibald pointed out that while Mr. Bragdon had spoken from the idealistic point, the American architectural papers were full of articles from the utilitarian point. The proposed increase of tariff on plans did not seem to conform with Mr. Bragdon's views of an interchange of architectural ideas with the States. Instead of raising a barrier they should favor this interchange of ideas. Mr. Wickson deplored the fact that so little color was used in the cities, and he suggested that architects should give more attention to this subject. Replying to Mr. Archibald, he declared that they must consider Canada, and give

Canadians the greatest opportunity possible for the development of their profession.

The question of color was then discussed by Messrs. Maxwell, Vallance, Beaugrand-Champagne and Miller. While it was said color should be used with discretion, exception was taken to the employment of red brick in such large quantities. Mr. Beaugrand-Champagne, however, pointed out that it was a question of using the material in hand, particularly in Montreal. For instance, they have the grey stone and used it, and the same applied to the red brick. Mr. Miller said that the reason for the employment of red brick was that the brick manufacturers had not put any half tones on the market.

The evening session was devoted to a consideration of post war housing. Mr. Thos. Adams, town planning adviser of the Canadian Commission on Conservation being the principal speaker.

Mr. C. H. Whitaker, secretary to the Post War Committee of the American Institute of Architects, was also to have spoken, but he sent a telegram regretting his inability to be present owing to illness, and expressing a hope that the Institute would appoint a committee to co-operate with the committee organized by the American Institute.

Mr. Adams first dealt with the action taken by the U. S. Congress in devoting \$190,000,000 for housing accommodation in connection with ship building and ammunition work. That programme of housing, he said, was unfortunately brought to a premature conclusion before being carried to complete success. The stimulus given to the American programme came from Great Britain, Mr. F. L. Ackerman having visited Great Britain and investigated what had been done there. Mr. Ackerman went across in the same boat with Mr. Adams. Mr. Adams then outlined what had been done in the old country, stating that Mr. Lloyd George had brought Mr. Raymond Unwin from the Local Government Board to investigate the matter of model committees. These had been set up with a view of increasing the output of munitions, and at Gretna Village, a permanent town for fifteen thousand people had been erected. It was realized that the contentment and efficiency of the workmen were to a large extent dependent upon good housing accommodation. Mr. Ackerman went back filled with enthusiasm as to what he had seen.

Coming to our own conditions, we were proceeding on a rather better line than in the States; there they were forced into the matter by war conditions, but since the termination of the war Congress had decided to stop the building of the houses that were not completed. Mr. Whitaker and Mr. Ackerman were trying to get the U. S. Government to continue these model schemes. In Great Britain, continued Mr. Adams, it was recognized that what was sound for war conditions was also good for times of peace. If it was a good thing for munitions, it was equally good for the production of woollens, steel, etc. It had been decided to invest a very large sum in the British schemes, even although a third of it would not be returned to the State. The schemes were to be carried out in co-operation with architectural experts. He was afraid there was a lack in this country of appreciation of the architect on the part of the public, and also a lack of appreciation on the part of the architect as to what would satisfy the public. There was, he thought, an objection on the part of the architects to standardization, and while he was not advocating standardization, he would rather have that than many of the abortions he had seen. There might, however, be a middle course. Canada had not established an housing policy during the war, but we had a post-war programme. The reconstruction programme of the Dominion and Provincial Governments was to be directed to improving the social conditions as well as the housing conditions. The Federal Government would offer \$25,000,000, at 5 per cent. to initiate the movement. Such problems as the waste of coal,

and the preventing of fire loss were also to be investigated. Mr. Adams continued that another of the problems was how to avoid waste by reducing the mileage, owing to the unnecessary width of roads. It was obvious that Canada had many miles of pavements, sewers, sidewalks, etc., that were not necessary, causing a great burden of taxation.

One of the first things to do was to get a good land survey, and thus prepare the way for town planning. He hoped that at the next session of the Quebec Legislature a scheme of town planning would be discussed. It was essential to investigate the housing question, and there should be a panel of the Institute to advise the Government on the question without payment, because architects would benefit from the adoption of town planning schemes. In Canada there had been no means of attracting architects to devote their attention to this subject.

Mr. Adams then considered the question of tenements versus two storey houses, and stated that in Great Britain a report made by experts favored the building of cottages rather than tenements. He argued against the high tenements, believing they led to the deterioration of the people. The Dominion Government would encourage the individual home, and if land was too dear then it should come down in value.

The congestion of street railway traffic was due to the fact that cities had grown up without proper town planning. In the States the Federal Government had undertaken the question of housing, while in Canada the scheme would be worked through the provinces and municipalities, housing associations, and even private individuals if the latter were owners of land. The Government desired to give a practical demonstration as to what could be done, and the rest could be left to private enterprise. He hoped that the architects would do their best to co-operate with the Government. The Federal, Provincial and Municipal governments should act together. Here was an opportunity for the architects to prove that they had executive ability as well as imagination, as it was essential to have a combination of these in order to secure success.

Mr. F. W. Stewart, president of the City Improvement League, referred to the efforts being made to solve the housing problem in Montreal.

Mr. Dandurand declared it was essential that immediate action should be taken on this question.

Dr. Atherton, secretary of the City Improvement League, referred to the past efforts to get better housing accommodation in the city, and told how these had been rendered of no account owing to the real estate people putting up the price of land.

Dr. Hodgetts, who has just returned from England, spoke with satisfaction at finding that Canada was moving along on the right lines. This country had proved self efficient, and if she was to maintain that standard, must provide good homes.

In reply to some question as to the means to be taken for securing co-operation among the various authorities, Mr. Adams stated that the cabinet would be the supreme authority in the matter of houses. He had been in consultation with the Housing Committee, and it had been arranged that he should direct the work of that committee. An office had already been taken for this purpose, and a staff would be employed, one of whom would be an architect with an assistant engineer. The first work would be to consider what suggestions would be made to the Provinces with a view to securing complete co-operation. It was a question of how far the provinces were prepared to go. Certain suggestions had been sent to the Provinces regarding standards and principals. In the Maritime Provinces a barrister had been appointed to work with the Government;

in Quebec no action had as yet been taken; in Ontario, Mr. F. A. Ellis has been appointed housing commissioner, besides which \$2,000,000 had been voted by the Provincial Government. In Manitoba the Government had held a meeting of municipalities, and a further conference was to be held next month; while in Saskatchewan an official under the Town Planning Act had been appointed. In Ottawa, last week, a meeting of representatives of the land surveyors, architects and Engineering Institute of Canada, was held, at which it was decided to form a Town Planning Institute for members of the various organizations named. Each member would have to go under examination, and must qualify within a year, the idea being to encourage town planning engineers within the ranks of these institutions.

Mr. J. Archibald stated that the Province of Quebec Association of Architects had been for years devoting attention to the subject of town planning. The great evil, in his opinion, was the speculative sub-division of land, and he suggested legislation should be enacted by which every sub-division should be sanctioned by a competent authority.

Mr. Wickson stated that in Toronto they had legislation of this character, which had proved beneficial.

At the session of the Institute on the 18th of January, the following officers were elected: President, Frank A. Wickson, Toronto; vice-presidents, David R. Brown, Montreal; W. C. Van Egmond, Regina; hon. secretary, Alcide Chausse, Montreal; hon. treasurer, John P. Hynes, Toronto.

The following are the members of the Council: Alberta Association of Architects—Messrs. G. H. Macdonald, R. P. Blackey, W. D. Cromarty; Manitoba Association of Architects: J. H. G. Russell, H. E. Matthew, H. Jordan; Ontario Association of Architects, C. A. Acton Bond, J. P. Hynes, C. P. Meredith, A. F. Wickson, A. E. Nicholson.

Province of Quebec Association of Architects: Herbert Raine, J. Perrault, J. B. Ouellet and Prof. Traquair; Saskatchewan Association of Architects, R. G. Bunyard, A. G. Creighton, W. Reilly, H. Cooper; Architectural Institute of B. C., S. M. Eveleigh and Kennerley Bryan.

The next meeting will be held in October, at Toronto, at the same time as the annual convention of the Ontario Association of Architects.

The following registered at the meeting: Messrs. L. Auger, Quebec; G. H. MacDonald, Edmonton, Alta.; A. F. Wickson, Toronto; J. P. Hynes, Toronto; C. H. Acton Bond, Toronto; A. Beaugrand-Champagne, Montreal; G. A. Monette, Montreal; J. Cecil McDougall, Montreal; Septimus Warwick, Montreal; V. D. Horsburgh, Toronto; J. S. Archibald, Montreal; W. D. Baillairge, Quebec; Edgar Prairie, Montreal; W. R. Reilly, Regina; J. L. Aird, Montreal; W. A. Gagnon, Montreal; R. H. Macdonald, Montreal; R. Gariepy, Montreal; L. A. Content, Montreal; O. Beaulé, Quebec; J. Venne, Montreal; A. Content, Montreal; Emile Venne, Montreal; Claude Bragdon, Rochester, N. Y.; E. Payette, Montreal; F. S. Swales, Montreal; D. A. Brown, Montreal; E. S. Maxwell, Montreal; J. R. Gardiner, Montreal; R. A. Frechette, Moncton, N.B.; C. E. Saxe, Montreal; A. Chausse, Montreal; Herbert Raine, Montreal; Philip J. Turner, Montreal; C. R. Tetley, Montreal; F. R. Foster, Montreal; J. C. Heriot, Montreal; J. T. St. Louis, Montreal; U. J. Asselin, Montreal; S. Frappier, J. P. Anglin, Montreal; L. A. Amos, Montreal.

Mr. J. G. Sullivan, former chief engineer of the Western Division of the C. P. R., has been appointed chairman of the Manitoba Drainage Commission. The other members are Mr. H. Grills, of Sanford, Man., and Mr. John A. Thompson, of Winnipeg. On February 1 this commission will begin its work of investigating the big problem of the province in regard to drainage and assessment.

Quebec Association of Architects Hold Annual Meeting

MR. G. A. MONETTE presided at the annual meeting of the Province of Quebec Association of Architects, held at the association offices, Montreal, on January 18th.

The report of the Council stated that six new members had been admitted during the year making a total of 170. Four members—Messrs. H. J. Hardenburg, H. C. Stone, J. H. McDuff and Edmund Burke—had died during the year. The Quebec section reported that they had a balance of \$200. The committee specially appointed at the instance of the chief engineer of the City Council, Mr. P. Mercier, reported that owing to the state of disorganization and frequent changes in the staff of the Public Works and other departments, it was impossible to have the new codification of building laws, as drawn up by Mr. J. Venne and Mr. W. J. Francis, put in force. Nevertheless, the Council of the Association had not abandoned its efforts towards that end, and would seize the first opportunity that presented itself so as to bring this important question to a satisfactory conclusion. The War Graves Committee had been in correspondence with the Government and others with the object of appointing an architect and a landscape gardener on the Canadian War Graves Commission.

The Council regretted that the cessation of hostilities had not as yet bettered the situation as to the building trades and construction in general and of course that of architects. There was, however, no reason to be discouraged, for the after-war developments in the Canadian industrial world, together with the awakening of the Governments as to very much needed public works, would surely re-establish such situation as would favor the profession.

The report was adopted.

The treasurer reported a balance in hand of \$1224.

A special report on certain amendments to the charter suggested by Mr. Prarie was read. These were in the direction of a commission of $2\frac{1}{2}$ per cent. being paid to young architects bringing work into the offices, regulating the hours of students, holding two general meetings in the year, and classification of members.

A letter from the Royal Canadian Academy on the subject of memorials to war heroes was read. The letter noted with approbation the movement towards the erection of suitable monuments to our noble soldiers, and to mark the graves of those who made the supreme sacrifice. The Academy, however, viewed with alarm the unguided enthusiasm directing these laudable efforts, and placed themselves on record regarding the necessity of entrusting these commissions to the most eminent sculptors and architects available in Canada, that credit and honor in the highest degree might result to those associated in the movement.

Mr. J. Venne suggested that in the matter of the principal public memorials, there should be a competition from recognized architects.

Mr. J. M. Miller spoke in support of the Academy's letter.

The following were appointed officers: President, Mr. J. H. Lebon; 1st vice-president, Mr. D. Norman MacVicar, 2nd vice-president, Mr. E. Payette; secretary, Mr. J. Emile Vanier; treasurer, Mr. J. M. Miller; members of the Council, Messrs. Beaugrand-Champagne, Jules Poivert, J. Asselin, L. A. Auger, and Prof. Traquair; delegates to the Royal Architectural Institute of Canada, Messrs. A. Chausse, Jos. Perrault, D. R. Brown, J. P. Ouellet, and Prof. Traquair.

The question of the Montreal civic building inspection came up, and it was stated that the city had passed an amendment to the by-law which required that the chief inspector should be an architect; under this amendment, any

man, whatever his business, could be appointed chief building inspector. It was stated that the council had protested against the appointment of anyone to the position, (which had been rendered vacant under a re-organization scheme) who was not an architect. A resolution was passed asking the city to expedite putting into force the new code of building by-laws, which has been prepared for some years, but which has been delayed.

The next annual meeting will be held in Quebec.

An Important Water Power Conference of Dominion and Provincial Interests

A most important conference of Dominion and Provincial Engineers was held in Ottawa, on January 16th and 17th, under the auspices of the Dominion Power Board, of which the Hon. Mr. Meighen, Minister of the Interior, is chairman. Mr. A. St. Laurent, the vice-chairman of the Board, who presided, stated that the recent crisis regarding both fuel and power had brought the tremendous importance of both very prominently to the front, and shown with greater force than ever the necessity of developing and conserving our water powers to the utmost. The first step to this end, seeing that various authorities are handling the problem in different parts of Canada, is to, as far as possible, arrange their methods and organizations along similar lines, viz., the standardization of field and office methods and equipment, uniformity of publications, both in matter and arrangement, period to be covered by each, etc., etc.

The administrative end also had to be considered, with a view to making the requirements and regulations of all the authorities concerned, whether Federal or Provincial, as uniform as possible.

There were present at the Conference, Messrs. H. G. Acres, chief hydraulic engineer, Hydro Power Commission, Ontario; Arthur Amos, chief engineer, Hydraulic Service, Quebec; R. J. Burley, Reclamation Service, Ottawa; E. F. Drake, Reclamation Service, Ottawa; C. O. Foss, chairman, N. B. Water Power Commission; T. W. Gibson, Deputy Minister, Crown Lands, Ontario; H. W. Grunsky, legal adviser, Dominion Water Power Branch; J. T. Johnston, assistant chief engineer, Water Power Branch; E. B. Jost, engineer, Department of Railways and Canals; R. S. Kelsch, consulting engineer, Montreal; O. Lefebvre, chief engineer, Quebec Streams Commission; K. H. Smith, engineer, Nova Scotia Water Power Commission; R. G. Swan, chief engineer, British Columbia Hydrometric Survey; Wm. Young, Comptroller of Water Rights, British Columbia; together with the following Ottawa members of the Power Board: A. St. Laurent, vice-chairman; W. A. Bowden, D. B. Dowling, B. F. Haanel, C. N. Monsarrat, John Murphy, J. B. Challies.

As a basis for a uniform system of locating any and all water resources, and analysing and filing all data of whatever kind concerning them, which is the first requisite to co-ordinated working, there was laid before the meeting a Water Resources Index-Inventory, designed by the Dominion Water Power Branch, and which the Dominion Power Board submitted as one which would suit the needs of any and all authorities concerned with water investigation, whether Federal or Provincial. The basis of the system is the dividing of the country into its main or basic water sheds, eleven in number, with sub-basin and other divisions. Combined with this are detail maps, a card index system, and a folder equipment, the whole forming an indexing and filing system adaptable to the needs of all the various organizations concerned with any type of water investigation or administration.

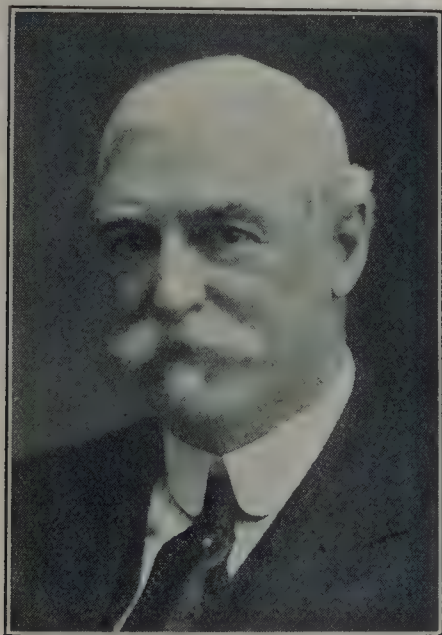
Following a lengthy discussion as to how various local conditions would be covered it was shown that the system was of such flexible and comprehensive nature as to be adaptable to practically any needs that were likely to arise. In view of

this, and of statements by several of those present that they already had the system in use in their offices, in whole or in part, a resolution was passed by the Conference recommending the adoption of the system by all Federal and Provincial authorities concerned, and further, to facilitate its adoption, that an explanatory monograph on it, accompanied by maps, diagrams, etc., be published for general distribution.

The next matter considered was the co-ordination of the work of investigating water resources; it being pointed out that in view of the fact that several Federal and Provincial organizations were at work on the same matter, in different sections of Canada, it would greatly help if their field and office procedure and their equipment, and finally their publications, could all be largely standardized, both as to form and contents. A resolution was passed recommending the yearly publication of hydrometric data, each report to cover a climatic year extending from October 1st to September 30th; and to include daily discharge records, but daily gauge heights only in those special cases where they are obviously necessary. The Power Board is to prepare and distribute a key map showing the territories covered by the different organizations and surveys. Other details were thought to be so many and so complex as to require extended consideration, and it was decided to leave them for definite decision at later conferences, one in the West and one in the East, after which another and plenary conference at Ottawa would make final recommendations on the whole subject.

Steel Company of Canada Expanding Rapidly

Mr. Robert Hobson is President of the Steel Company of Canada, Hamilton, which has recently installed a \$3,000,000 coke oven plant and has started work on a modern office building. Mr. Hobson is one of the best known steel men



Robert Hobson, President of the Steel Company of Canada, Hamilton

in the Dominion. He is a director of the American Iron & Steel Institute, and in 1908 was President of the Canadian Manufacturers' Association. He is also connected with many other enterprises, being a director of the Dominion Power & Transmission Co., Hamilton, of the Canadian Locomotive Co., Kingston, and of the Canadian Northern Ry. Mr. Hobson is a member of the Honorary Advisory Council for Scientific and Industrial Research.

F. G. Engholm & Partners, Limited

The announcement has just been made of the formation of a new partnership under the name, F. G. Engholm & Partners, Limited, Civil Engineers and Specialists in Reinforced Concrete Construction. The new organization has offices in Toronto, 304-5 Excelsior Life Building (Mr. F. G. Engholm); Montreal, 511 Coristine Building (Mr. G. G. Underhill); and Vancouver, 1005 Dominion Building (Mr. E. J. Leveson). The new firm takes over the business of L. G.



Mr. F. G. Engholm

Mouchel & Partners, retaining their association with the parent company in London, England, and with the Francois Hennebique organization in Paris; retaining also the sole rights in Canada for the Hennebique system of reinforced concrete construction.

The president, Mr. F. G. Engholm, and vice-president, Mr. Underhill, are both well known in Canada in the construction field. Mr. Engholm was educated in England and, after completing an engineering course, served an apprenticeship with Messrs. James Simpson & Company, of London and Newark. He has had wide experience in reinforced concrete construction. Since coming to Canada he has been prominently connected with some of our finest examples of construction work in reinforced concrete, such as the Vancouver Club, Birks Building, St. Paul's Hospital, Vancouver, B. C.; Belmont Building, Victoria, B. C.; Trusts & Guarantee Building, Masonic Temple, Duncan Street Sub-station of the Toronto Hydro-Electric System, Allen Theatre, Toronto; office building for Public Utilities Commission, London, Ont.; the handsome new bridges for the City of Montreal over the new aqueduct; as well as bridges being built for the Toronto-Hamilton Highway, etc.

Mr. Underhill is a graduate of the College of Civil Engineering, Cornell University, and has had intimate and continuous knowledge for the past ten years in the capacity of superintendent, and higher positions, of practically every phase of general engineering, among which may be mentioned his work as manager and chief engineer of the Boquilla Dam for the Mexican Northern Power Company, and as construction manager for Fraser Brace & Co., Ltd., the well-known Canadian firm of general contractors.

F. G. Engholm & Partners have a highly trained staff at their disposal and are prepared to undertake the design and superintendence of construction of reinforced concrete work of every description. We wish the new firm every success.

Commissioner Harris at Toronto Section A. I. E. E.

It was a very interested assembly which listened to the lecture by Works Commissioner R. C. Harris, at the Engineers' Club, on Friday, January 17, on the occasion of the Toronto Section A. I. E. E. semi-monthly meeting. The subject of the lecture was the Bloor Street Viaduct and this was, we think, the first time since the viaduct has been opened that it has formed the subject of an authoritative address. Mr. Harris in his usual attractive style gave a historical sketch of the development of the city of Toronto east of the Don River and showed how for a long time the means of access across the valley had not kept pace with the growth of this district. This territory was first approached by a low level bridge crossing the Don at Queen Street which also intersected the main lines of the C. P. R. and the Grand Trunk Railway on the level. In these days the only transportation east of the river was afforded by a gravel train which, hauled by a wood burning locomotive traversed the two and a half miles from the Don bridge to Ben Lamond, (now St. John's cemetery) and occasionally hauled a double decked passenger car. The situation was improved when the high level bridge was erected at Queen Street; also by the construction of the viaducts at Gerrard Street and Wilton Avenue. At the same time the population had increased so as to demand still greater facility of access, for in 1918 the inhabitants of the city east of the Don amounted to more than those in all the city of Hamilton.

The first proposal for a bridge on the site of the present structure was made about twenty years ago and was based on the crossing being made at a low level there being a down grade approaching the bridge on each side. Several alternative proposals were subsequently submitted, but for many years it was impossible to secure the vote of the people in favor of the scheme. During the regime of Mr. C. H. Rust, as city engineer, a more ambitious plan was introduced by which the alignment would be constant throughout from Bloor Street to Danforth Avenue; this would have necessitated considerable structural work to bridge the Rosedale Ravine at a very small angle and all things considered it was thought better to adopt the plan which has now been followed. In this the roadway swings south from Bloor Street and skirts the southern side of the ravine turning north so as to cross it at the head of Parliament Street. It then swings east in direct alignment with Danforth Avenue and crosses the Don on five magnificent spans. The width is maintained at 86 feet throughout.

The foundation proved a matter of some difficulty as it was found that the rock shelved away very rapidly on approaching the river bed and it was necessary to go down forty-six feet to reach bedrock. The matter of steel versus concrete was very thoroughly debated and an engineer from the Works Department visited a number of installations in the United States to gather information on this point. It was found that the best and most conservative opinion was in favor of steel for a structure of this size in the latitude of Toronto, and the decision was made to employ steel for the Bloor Street Viaduct.

Mr. Harris showed quite a number of slides depicting different aspects of the work and the photograph of the engineers concerned was received with enthusiasm. In moving a vote of thanks to Mr. Harris, Mr. MacLachlan commended the idea of having frequent addresses on matters of local engineering interest. There were right here in Toronto works of a magnitude unsurpassed anywhere in America and as a rule the citizens were most ignorant of them.

A by-law for raising \$50,000 by debenture for waterworks system extension at Pembroke, Ont., was passed.

Mainly Constructional

East and West—From Coast to Coast

Hyde Engineering Works, Ltd., has been incorporated with a capital of \$100,000, head office at Montreal.

The Union Iron & Metal Co. has recently been incorporated with capital of \$100,000, headquarters in Toronto.

The Redonda Iron & Copper Co., Ltd., has been incorporated, with a capital of \$100,000, head office at Vancouver.

The city commissioners of Montreal have voted a credit of \$28,000 for the completion of work on culverts at the aqueduct.

The Pacific Marine Engineering Co., Limited, has been incorporated with a capital of \$10,000, head office at Vancouver, B.C.

There is some agitation in Regina, Sask., to have the Hamilton Street subway constructed during the current year. The cost would be \$70,000.

It is stated that the directors of the Wabasso Cotten Co. have under consideration further extension to their mills at Three Rivers, P.Q., at a cost of \$300,000.

The Canadian H. W. Johns-Manville Co., Ltd., has been registered as an Extra-Provincial company in British Columbia, with local headquarters at Vancouver.

The St. Thomas, Ont., city council has been asked to secure a loan from the Government to build at least one hundred dwellings, the cost to be about \$2,500 each.

The Resida Mining & Exploration Co., Ltd., has been incorporated with a capital of \$20,000, head office in Montreal. It is authorized to go into mining and lumbering.

The Peter Lyall Co. and the Pacific Construction Co. will apply under the Dry Dock Subsidies Act for a grant in assistance of a six million dollar graving dock at Vancouver.

An association was recently formed at a meeting at Fort Coquitlam, B. C., to promote the construction of a hard surface road from Mission to New Westminster and to Vancouver via Port Moody.

A deputation recently waited upon Hon. Geo. A. Grier, Minister of Public Works for the Province of Manitoba, to request assistance in building a pontoon bridge over the Red River at St. Jean.

The Community Club at Franklin, Man., proposes the erection of a memorial hall to the memory of the fallen soldiers. Other community clubs at various points in Manitoba intend similar action.

The South Waterloo Trades & Labor Council recently sent a request to the city council of Galt, Ont., that a clause be inserted in all invitations for tenders, stipulating that the prevailing trade union rate of wages must be paid.

The Plasterers and Cement Finishers have served notice on the Toronto Board of Education that they are now asking higher wages—a rate of 55 cents an hour instead of 52½, and 60 cents an hour for foremen, with time and a half for overtime.

The Board of Trade, of Vernon, B.C., proposes to send a delegation to Ottawa to press for the speedy construction of a branch of the Canadian Northern from Kamloops into Grande Prairie and Salmon River Districts, as far as Kelowna, with a spur from Vernon to Lumby.

There were 153 building permits issued in Waterloo, Ont., during the year 1918, valued at \$226,062. Twenty-one of these permits were for residences, valued at \$49,200; 17 for

business buildings, totalling \$143,500; alterations and repairs, 29, at \$19,412; garages, 85, valued at \$13,950.

The Canadian Cartridge Company, of Hamilton, Ont., which during the war operated to the extent of 100 per cent. on war work, proposes to go into the manufacture of metal stampings and drop forgings and steel barrels.

Mr D. B. Hanna, president of the Canadian Government Railways recently announced that if the Government passed the C. N. R. estimates a new depot would be erected in Hamilton, Ont., which would be a credit to that city.

Mr. E. W. J. Hague, assistant health inspector, of Winnipeg, states that more than 50 per cent. of the vacant houses in that city are unfit for habitation. A housing survey has been made with the object of taking action to relieve the present situation.

Construction work on the Government bridge across the Canadian Pacific track, at Castlegar, B. C., which will lead to the new ferry, has been stopped, as it has been decided to let the balance of this work and the piling in connection with ferry landings out by contract.

The Essex Border Utilities Commission is calling for tenders for an issue of \$210,000 of debentures for the construction of the trunk sewer for the municipalities of Walkerville, Ford City, Sandwich, Ojibway, and the townships of Sandwich East and Sandwich West.

Considerable construction will be done in the spring by the Canadian Government, both in the east and the west, according to Mr. D. B. Hanna, particularly in districts where grading has already been done years ago, but the completion of the line has been held over owing to the war.

The London Builders' Exchange has just recently announced an agreement with the Bricklayers' Union, by which a five-cent increase in the rate per hour has been granted. The minimum wage is now 70 and 72 cents. Bricklayers' laborers are also to receive wage increases, it was stated.

The Canada Wire & Cable Co. Ltd. are installing machinery for manufacturing a full line of steel wire rope in their plant at Leaside, Ont. They expect to have this plant in operation by March 15th, 1919, and will then be in a position to supply all sizes and kinds of steel wire rope.

At a meeting held recently in Niagara Falls, N.Y., the scheme for the erection of a Peace bridge over the Niagara River, which was interrupted by the war, was revived, and a committee of ten—five Canadians and five Americans—is to be appointed to further the matter. It is proposed that the cost of the bridge, which will be free, will be borne equally by the two governments.

City Engineer Brazier, of London, Ont., states that three or four miles of pavements, four miles of sidewalks, seven miles of curbs and gutters and several thousand feet of sewers could be laid this year by his department. This would be one-third of the pavements, all of the sidewalks and half of the curbs and gutters for which by-laws were passed by former councils. In order to complete all of this work, an early start would be necessary. This would be in addition to the regular work of the department, such as repairs, etc.

As a further means of assisting returned men who wish to settle on the land, it is stated that the Government architects are preparing plans for standardized houses and barns for farms and families of varying sizes. The material is to be sold to the settlers at cost, ready made, if feasible. Legislation will be introduced to grant soldiers money up to \$6,500 at 5 per cent., the recipient himself to invest up to 10 per cent. of the amount. The money is to be used as follows: For purchase of implements, buildings and stock,

\$1,500; purchase of farm, improved or unimproved, at valuation of Government appraisers, \$5,000.

The Dominion Foundries & Steel Co., of Hamilton, Ont., plans in its adjustment to a peace basis of operation, the installation of a plate mill with a capacity of 10,000 to 12,000 tons a month. The size of plate that will be rolled will be 42-inch universal and 84-inch sheared, which will be suitable for shipbuilding, bridges and structural work. Final decision to go ahead with this venture has not been made yet, but it is believed that it will be undertaken in the very near future. The erection of a pattern building, costing \$75,000, is being proceeded with and an office building is also being planned for at an equal expenditure.

In regard to the unemployment problem, Rev. J. A. Miller, superintendent of the Ontario Government Labor Bureau, recently stated that the situation, though serious, was certainly not alarming. He had no hesitation in saying that the number of unemployed in Toronto did not exceed 10,000. "When the machinists, some weeks ago, were reported as saying that nearly 24,000 were out of work, they must really have meant that this number had been temporarily discharged from government work, such as munitions, and they were disengaged, ready for other openings. As a matter of fact, unemployment is marked, not among the skilled, but among the unskilled workers."

A Hamilton deputation is to wait on the Dominion Government to request that provision be made in this year's estimates for public works calling for an expenditure of about two and a half million dollars. The Government will be urged to commence work on the harbor development scheme which will cost some \$1,500,000. This scheme embraces the purchase of the Stipe's farm and its conversion into a large basin and channel where steamers will be enabled to turn around without backing out into the bay from their slips. Other works to be asked for include: Extensions to new post office, \$500,000; new branch post-office, Barton Street, \$75,000; the construction of a grain elevator.

Obituary

Mr. James MacFarlane, who for 52 years was chief engineer of the Beach Pumping plant, at Hamilton, died on January 21, at the age of 90.

Mr. Joshua Limerick, a former resident and ex-alderman of Fredericton, N. B., died recently at his home in West Somerville, Mass. Mr. Limerick was a well-known contractor and builder, having constructed the Woodstock Post Office, the Fredericton High School, Charlotte Street School and many other prominent buildings.

Mr. Geo. Sherwood Hodgins, editor of *Railway and Locomotive Engineering*, died on January 19, following an attack of pneumonia. Mr. Hodgins was born in Toronto and for a number of years was a mechanical engineer for the Canadian Pacific Ry. Going to New York about 20 years ago, he had since been engaged in editorial work, and had also given much attention to scientific research work. He was in his 59th year.

Mr. Morley Leopold Smith, Director of Engineering at the Toronto Technical School, met his death under tragic circumstances, on January 18. Mr. Smith was examining parts of the boiler in the school, and having crawled underneath it carrying an extension light from the Hydro service, by some mishap he created a short circuit with his body and was dead before he could be taken out by the workman who was with him. Mr. Smith was a 1911 graduate of the Faculty of Applied Science and Engineering, University of Toronto. He was in his 38th year.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Aylmer, Que.

Town Council plans improvements to streets throughout town. Mayor, H. Therien.

Bobcaygeon, Ont.

Municipal Council plans installation of pipes and hydrants for fire protection. Clerk, C. E. Stewart.

Galt, Ont.

By-law has passed for construction of sewer, cellar and storm drain on Forest Road for City Council. Clerk, Jos. McCartney.

Goderich, Ont.

Town Council plans construction of sewers. Mayor, Mr. Wigle.

Newmarket, Ont.

Plans are being prepared for addition to water supply system for Town Council. Engineer, James, Loudon & Hertzberg, Excelsior Life Bldg., Toronto. Clerk, P. J. Anderson.

Port Rowan, Ont.

Town Council plans extensive road improvements in spring. Clerk, W. A. Mabey.

Renfrew, Ont.

Town Council plans repaving streets. Mayor, Mr. Bolan.

Scarboro, Ont.

Township Council plans construction of water system and installation of fire protection system. Clerk, W. D. Annis.

Toronto, Ont.

Works Commissioner R. C. Harris has recommended the following paving: Granite block costing \$14,887, and curbs, etc., costing \$640, on Gerrard St.; asphalt costing \$23,038, and concrete curbs costing \$1,256 on Bartlett and Geary Avenues.

Department of Public Works, Toronto, will call tenders shortly for construction of one hundred miles of road. Minister, Hon. F. G. MacDiarmid, Parliament Bldgs.

Wyoming, Ont.

Township Council plans drainage work. Clerk, T. Nesbit.

CONTRACTS AWARDED

Mount Elgin, Ont.

Township Council has awarded contract for drain to Wm. Freeland, care of Clerk, Alex. Bell.

Walkerville, Ont.

Town council has awarded contract for \$6,000 sewer to Pettypieces Ltd., Amherstburg.

Railroads, Bridges and Wharves

Cornwallis, Man.

Tenders are being received by clerk, D. W. Shaw, Brandon, until March 5th,

for construction of bridge for Municipality.

Montreal, Que.

Canadian National Railway plans construction of railway between here and La Tuque. Asst. manager, W. A. Kingsland.

Canadian National Railway plans construction of branch railway line from here to Cartierville.

Vancouver, B.C.

Barrett Co., Ltd., 2100-10th Ave. W., plans construction of wharf. Engineer, J. F. Miller, care of owner.

C. P. R., Montreal, is preparing plans for construction of \$1,000,000 ocean pier. Res. engineer, W. L. Coddington.

Welland, Ont.

Tenders are being received by clerk, Miss C. M. Stapf, until 4 p.m., February 4th, for repairs to Welland River bridge, including pile-driving and new floor, for City Council.

CONTRACTS AWARDED

Vancouver, B.C.

\$7,000 wharf for Watson Bros.: General contractor, S. J. Newitt, 654-17th Ave. W. Architects, Gardiner & Mercer, 827 Birks Bldg.

Public Buildings, Churches and Schools

Alliston, Ont.

Town Council plans repairs to town hall. Clerk, J. E. Addis.

Bowness, Alta.

Plans are in progress for erection of sanitarium costing \$460,000 for Provincial and Dominion Governments.

Chicoutimi, Que.

Roman Catholic Congregation plans erection of church. Curate, Rev. Almas Larouche.

Collingwood, Ont.

Board of Education plans erection of technical school. Chairman, W. J. Honeyford.

Cow Head, Nfld.

Plans will be prepared at once for church and rectory costing \$8,000 for Anglican Congregation. Pastor, Rev. G. A. Maidment, Bonne Bay.

Downeyville, Ont.

Work is to start for parish hall for St. Luke's Congregation. Priest, Rev. Father Galvin.

Enderby, B. C.

Enderby Hospital Board plans erection of isolation ward at hospital costing \$4,000. Prices on material and equipment wanted at once.

Fredericton, N.B.

Church of England plans erection of

synod hall. Bishop of Diocese, Rt. Rev. J. A. Richardson, D.D.

Hull, Que.

City Council plans repairs to police stations. Mayor, Mr. Archambault.

London, Ont.

Plans are in progress for quasi-military school costing \$100,000 for Roman Catholic Church. Bishop of Diocese, Rev. M. F. Fallon, O.M.I., D.D.

Tenders will likely be called in March for erection of \$400,000 stone seminary for St. Peter's Parish.

Montreal, Que.

Montreal Homeopathic Hospital, 44 McGill College Ave., plans erection of \$100,000 hospital. Secretary, J. T. Novinger, M.D.

Maisonneuve Presbyterian Church plans repairs and improvements to church costing \$3,000. Pastor, Rev. R. L. Ballantyne, 28 Terrasse Viau.

Hebrew Maternity Hospital plans erection of extension to hospital costing \$50,000. President, M. Markus, 890 Cadieux St.

Outremont, Que.

Department of Public Works, Ottawa, plans erection of \$50,000 post office building.

Sacre Coeur de Marie, Que.

Plans are drawn and tenders will be called in two weeks for erection of \$150,000 church for Parish. Architect, Ludger A. Robitaille, 203 St. John St., Quebec.

South Vancouver, B.C.

Municipality has secured site for erection of high school. Commissioner, F. M. Gillespie.

Toronto, Ont.

The Board of Control has instructed the Property Commissioner, D. Chisholm, to prepare report on cost, etc., of new court house. Secretary, Thos. McQueen, City Hall.

Verdun, Que.

Tenders are being received by architect, D. J. Spence, 246 Beaver Hall Hill, Montreal, until February 3rd., for erection of two wing addition to school costing \$250,000, for Protestant School Trustees.

Victoria, B.C.

School Board plans erection of school. Chairman, Geo. Jay.

Youngstown, Alta.

Department of Agriculture, Edmonton, has secured site for agricultural farm and will proceed soon with erection of buildings. Minister, Hon. Duncan Marshall.

CONTRACTS AWARDED

Hamilton, Ont.

Sunday School for Presbyterian Mission, 465 Wentworth N.: Masonry and steel, Isbister Bros., 142 Emerald S.;

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Organization of Toronto District Branch of A.C.B.C.I.

THE decision of the Toronto Builders' Exchange at the recent annual meeting to amalgamate with the Association of Canadian Building and Construction Industries, means the establishment of the Toronto District Branch of what will undoubtedly be one of the most, if not the most, far-reaching and powerful associations ever organized in Canada.

The local Builders Exchange offers a splendid nucleus around which to build a substantial district branch. The limitations of the old exchange are now eliminated and the general invitation extended to all interested in the industry to unite for the common good should certainly receive prompt action.

The Builders' Exchange has been most useful and beneficial to its members, but for some time past it has been felt that something broader in its scope was necessary to meet the needs of the progressive period that must ultimately develop after the era of depression caused by the war.

To secure uniformity of endeavor throughout Canada, the closest kind of co-operation must be se-

cured and this co-operation must include everyone directly or indirectly interested in the trade. Heretofore the trade contractors or material supply men have been more or less on the outside. These men are big factors in the industry, just as important and necessary as the general or sub-contractors. In fact, at the present time, when material prices are the dominating influence in the industry, the importance and necessity of the material men's co-operation is amply evidenced.

No man interested in the building industry, however small he may be, can be benefitted without transmitting some portion of this benefit to the industry at large. The reverse also obtains. Consequently, it is the aim of the association to do all in its power to aid the little fellow in an endeavor to make a big fellow out of him and thus increase the power and effect of his influence.

One of the very first tangible returns to the Toronto District Branch will be the extension of its zone of operation to include outlying districts. These towns and villages should furnish a representation that will carry considerable weight and will add greatly to the strength of the organization.

The steps taken by the Montreal and Toronto Exchanges in organizing to form branches will undoubtedly be followed by other centres, and the association should very soon be in active and successful operation.

Definite Plans Lacking for Solution of the Housing Problem

IT is a rare thing to hear of men receiving a fair day's wage for a fair day's work, living with their well-provided-for families in comfortable homes, and at the same time leaning to Bolshevism or the doctrine of excesses. A contented workman, who receives even approximately a fair return for his labor, strives for bettering the whole social condition rather than destroying one social structure in order to set up another.

A man's home is held sacred above all things. Take his home away and you will produce a wanderer living under conditions resulting in the development of incipient Bolshevism. To permit of the existence of slum districts in Canada means the encouragement of social unrest, a condition that, once established, is exceedingly difficult to overcome.

Industrial employees should be carefully housed—homes must be provided for them and an endeavor made to raise the standard of living. Assist the great producing class to be more useful to themselves and to the country by evincing an understanding of their hopes, desires and aspirations. This will require sympathetic co-operation and a comprehensive plan of education to improve living conditions and make their homes comfortable and attractive.

The Government has arranged for financial assistance in an endeavor to meet the housing problem, but there appears to be a lack of a comprehensive scheme to assist and co-operate with industrial manufacturers and other agencies to begin new peace-time housing developments. It appears to us that to secure the best results, more than Government financial assistance is required. This assistance should be extended to include governmental direction and supervision, possibly by the organization of a department subsidiary to, and under the control of, the Department of Public Works.

It is imperative that some recognized body should

take immediate action on this vital problem. It will not be sufficient to offer assistance and then mark time until some substantial organization comes forward, of its own initiative to fill the breach. Surely it would be possible for the Government to take over this work itself?

Canada's Position in Regard to Production of Steel

IN a recent address before the Canadian Manufacturers' Association in Toronto, Col. David Carnegie, of the Imperial Munitions' Board, discussed Canada's position in regard to the production of steel and the possibilities of developing her export trade in this line. He pointed out that in Canada we have fine deposits of magnesia, developed during the war, which is of excellent value for our furnaces, making it unnecessary to import, as hitherto; that our carbon electrodes are second to none and cheaper than produced in England; and we have nickel in abundance. "Everything, in fact, calls for Canada to rise to the first rank as a producer of high quality steels. She has the opportunity by sustained and wise propaganda of displacing much of the heavy, cumbersome, short-lived, common carbon steels used in our rolling stock, ships, dredges, docks, mines and general machinery, and of becoming one of the principal exporting countries in the world. The things I have named—power, electrodes, magnesites and nickel—enter so much into the vital cost of producing high-grade steels that Canada stands out almost alone in its great opportunities in this direction."

Col. Carnegie did not think there was much prospect of France requiring to import steel. Considering her resourcefulness, especially with the restoration of Alsace and Lorraine, there seemed to be no doubt that she would be able to repair her waste places without calling on other countries; and not only this, but some believed she would also be a formidable competitor with Britain and other industrial nations in the export of her surplus productions to foreign markets.

As for Belgium, it was believed she would need to buy iron and steel products for one or two years while she was rebuilding, but after that she would return to her former place as an exporter, particularly of rolled steel and cast steel products.

Regarding Britain, the amount of work likely to be secured through Government channels for public works will no doubt exceed the pre-war annual requirements, owing to most of the ordinary Government contracts during the war having been suspended, said Col. Carnegie.

He said Canada had increased her steel production per annum from one million tons before the war to two and a quarter million tons at present. U. S. steel production had increased from 32 million tons to 45 million tons, and Britain's from 7½ to 12 million tons per annum.

Touching on Britain's high cost of production compared with pre-war costs, Col. Carnegie said that while Britain has a capacity to supply her domestic requirements, she will have a struggle to maintain both her home and export trade against American and Canadian competition.

Canada's Opportunity

"What are the prospects of utilizing the capacity for iron and steel production in Canada? The facts show that Britain has a capacity for steel production exceeding her pre-war capacity of 62 per cent., while

Canada's capacity has increased 125 per cent. If Canadian manufacturers will follow Britain's example by determining to supply her domestic trade more fully than in the past, Canada will go a considerable distance in using her surplus steel capacity."

"Canada should have at least one structural mill," said Col. Carnegie, "for rolling heavy sections."

"The home demands alone of the electrical industry for higher quality steel sheets is not by any means insignificant, and should be supplied by our manufacturers who have finishing mills."

The growing demands for alloy steels for motor cars, tractors and all kinds of engines and high-class machinery where excessive wear calls for a better and more enduring steel, should arouse the most earnest attention of the makers of electric and crucible steel.

The importation into Canada of tool steel, file steel and files, spring steel and springs should be reviewed by the makers of high-class steel. There is no doubt that a much larger volume of that business should be undertaken by the manufacturers of Canada."

Canada's electric power was an asset not yet fully appreciated and understood by the manufacturers.

Export License Eliminated in Wide Range of British Goods

THE British Trade Commissioners in Canada (Mr. G. T. Milne at Montreal, and Mr. F. W. Field at Toronto), have received cable advices from the Department of Overseas Trade (Development and Intelligence), that the following wide range of British manufacturers have been placed on the free list, and now require no export license:

Artists' materials, athletic goods, bicycles but not tires, bicycle accessories (various), buttons except military, horn and vegetable ivory, cigar and cigarette holders, china and earthenware, china clay, clocks, cutlery, drugs (various), fancy goods of paper, ivory, leather, etc.; films subject to censorship, flower seeds, fountain pens, furs (dress, dyed or manufactured); glassware, hardware (iron and steel builders); hats, household effects of wood, iron or steel, ink, jewellery (imitation or pearl), laces, laundry machinery, ledgers, marble, mineral waters (unsweetened), musical instruments, office furniture, pictures, paintings, phonographs, photographic materials (not chemical), razors (safety and blades), ribbons (silk), spectacles, sewing machines, wallpaper.

Lists of goods for which export licenses are still required for shipment from the United Kingdom will shortly be in the hands of the British Trade Commissioners noted above. They will also be advised weekly, by cable, by their department in London of the goods removed from such list and any alterations thereto.

The British Trade Commissioners will be glad to take up these matters with local importers and others interested.

The following are some of the principal commodities for which licenses are still required:

Abrasives, agricultural machinery, cement, chemicals (various), coal and coke, oils, pipes (cast iron), packing cases, railway material, resins, coal tar products, copper (wrought and unwrought, including wire); alloys, dyes, foodstuffs, food for livestock, glue, iron angles, bars, billets and constructional material, steel angles, ingot plates and similar raw materials, textile machinery, textile yarns, fibres and waste; tin plates, war material, wire rope, wood and timber.

Montreal Exchange Joins Association of Canadian Building and Construction Industries

OPTIMISM characterized the annual meeting of the 'Montreal Builders' Exchange—now to be known as the Montreal Association of Canadian Building & Construction Industries—held on January 27th, at the Drummond Building. The Exchange has gone through a period of depression, but has come out on the right side, the financial statement showing a balance in hand, while the exchange is also free from debt.

Mr. J. P. Anglin presided.

The financial statement, read by Mr. D. K. Trotter, the secretary, was adopted, and the members proceeded to consider the report, adopted by a special meeting, for widening the scope of the Exchange. The main provisions of this report have already appeared in the Contract Record, and it is sufficient to say that the organization will be divided into three sections of the industry: general contractors or contracting engineers; separate or sub trade contractors; and supply houses, manufacturers, and producers of building material.

Following this, the members discussed amendments to the by-laws suggested by a special committee, with a view to correspond with the wider scope of the organization. It was decided to change the name as stated above, with the addition of the words "temporarily operating the Montreal Builders' Exchange."

The question of the length of time a firm or person should be in business before becoming eligible for membership was also discussed. The committee recommended twelve months, but it was agreed to strike out any reference to time.

With regard to dues, the committee submitted al-

ternative proposals, one being for a fee of \$30 per annum, each section to pay \$200 per annum as rental, and the other a graduated scale according to the amount of business a firm transacted. The directors also to have power to assess members not more than 20 per cent. of the dues in order to meet any special contingency.

Mr. W. E. Ramsay moved and Mr. Vincent seconded, that the dues be \$30 per year, the directors having the power to levy the 20 per cent. assessment if necessary. The discussion was mainly on the point as to the advisability of having a standard fee, or of grading the fees according to business done, Mr. Ramsay strongly arguing that the latter would be a barrier to securing further members. Mr. Ramsay's motion was agreed to.

The election of officers resulted as follows: President, Mr. W. M. Irving; vice-presidents, Messrs. John Quinlan (representing the general contractors' section); Fred B. Locker, (trade contractors section); J. K. McNutt, (supply dealers section); past president, Mr. J. P. Anglin; honorary-treasurer, Mr. J. E. Walsh; honorary-secretary, Mr. R. A. F. Dykes; representative directors, general contractors section, Messrs. Donald Church, E. B. Evans, H. Fussing, trade contractors section, John Watson, I. Crepeau, F. J. Parsons, James Griffin, supply dealers section, Alex. W. Bremner, John Grieve, A. F. Daly, J. P. O'Shea.

In his retiring presidential address, Mr. Anglin alluded to the fact that they met under much more pleasant conditions than had been the case for three or four years. Last year he predicted that 1918 would, from the business point of view, remain much about



Mr. W. M. Irving, President Elect, Montreal Association of Canadian Building and Construction Industries



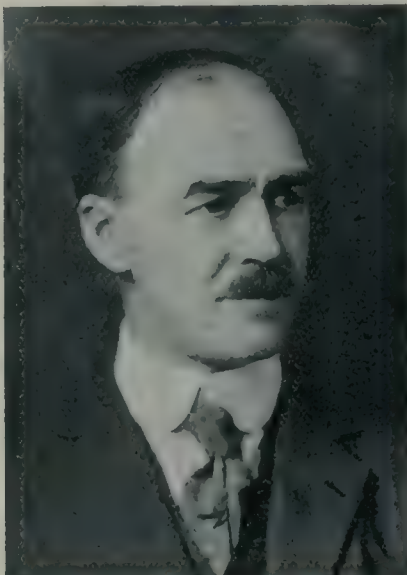
John Quinlan, Vice-President Representing General Contractors' Section



Mr. J. P. Anglin, Retiring President, Montreal Builders' Exchange



F. B. Locker, Vice-President
Trade Contractors' Section



R. A. F. Dykes, Hon. Secretary



J. E. Walsh, Hon. Treasurer

Officers of the Montreal Association of Canadian Building and Construction Industries for 1919

the same as in the immediate two or three years. The figures had borne out his prediction, for in forty-one cities the total business recorded was \$38,000,000, as against \$34,000,000 in 1917.

While he was a fairly good prophet as to 1918, he was not going to predict what would happen in the present year, as there was nothing sufficiently definite on which to base any summing up of the situation. Personally, he was very optimistic as to the future, especially of the next two or three years, but at the



J. K. McNutt, Vice-President,
Representing Supply Dealers' Section

same time, events were taking place all over the world which were so momentous that he felt that no one could be certain. One thing, however, was sure—there was a gradual reduction in the prices of some building material, and he expected this to continue moderately for some time. There was also an over supply of labor and that would probably be accentuated during the next few months with the return of the soldiers.

Referring to prospects, Mr. Anglin pointed out

that the Federal Government had decided to proceed with public works, which will probably cost in the neighborhood of \$60,000,000, and also to expend \$25,000,000 on a housing scheme. This made a total of \$85,000,000, and would probably result in the real estate men and the builders getting together, as he believed the greater portion of the money would be used within the next two or three years. The inquiries that were coming in were of two classes. One was for the extension of existing industries, there being few inquiries for new industries. He believed that this was owing to the fact that many of the peace lines in Canada had been held up during the war, consequent on war demands, and naturally the extensions for peace industries were postponed, and the building trade might look for some work in this direction now that the war was over. The other direction in which there was a demand was for apartments in large centres, and better houses than those contemplated by the Government. In his opinion the business that would come in from these forty-one cities should increase at least 50 per cent. during the current year.

The contracting business, continued Mr. Anglin, in the past had not been on a very sound basis. He did not think it necessary to give many facts to substantiate this statement. A great many men had failed, and they must look with hope to the future for the elimination of the unfair competition to which they had been subjected, as this came from a class which now no longer existed. The real purpose of the organization was to stabilize their industry; this was indeed the motive power of the conference at Ottawa. In Toronto the Builders' Exchange were holding a similar meeting to their own, and if mental telepathy meant anything, it meant that they were being organized on similar lines to their own. The stabilizing and organizing the industry was a gigantic task, the difficulties of which were not perhaps generally appreciated. The chief difficulty was that so little interest was taken in the matter. The old organization had done good work which had benefited those who were members

as well as those who were not, and Mr. Anglin cited the action of the Exchange on the lien law as an example of this character. There were many other instances where good work had been and could be done by the organization. The fact was that they had not been properly organized to meet present conditions. Mr. Anglin proceeded to point out that under the new organization certain drawbacks under the old conditions were obviated. It was now possible he said for the general contractors and others to come together in an organization of this kind in a way that was not feasible before owing to the dissimilarity of interests. In order to give every man in the industry a chance to meet the members, and to explain what the new association meant, he suggested the holding of a banquet, to which every one connected with the industry in Montreal and district should be invited.

In thanking the members of the Board for their support, Mr. Anglin said that Montreal had the credit of starting this new Canadian-wide organization. The attendance at the conference was proof of the feeling

that there was need for such an organization, his only regret was that it was six years too late, as if it had been in existence before the war, the builders could have rendered greater service to the country. The industry had lost considerable prestige during the last four years. Even if the association had been organized a year ago, the industry could have got in on the present situation with better chances of success. Readjustment was coming, and there were many building materials in this country which were required abroad, and the industries they represented should be able to put their possibilities in front of those who required such materials. In fact he would go so far as to say that Canada should be able to reconstruct a whole section of the devastated area, and why not, seeing the name that Canadians had made abroad. It was a matter of regret to him they were not in a better position to place these matters before the proper authorities. He asked for their further support for the Montreal association, and also for the Canadian-wide association.



President, Harry Hayman



First Vice-President, L. A. Boss



Second Vice-President, E. Gerry



Honorary Secretary, Geo. S. Gould

Officers for 1919 elected at the 21st Annual Meeting of the London Builders' Exchange which was the largest attended and most enthusiastic in its history.



Treasurer, Thos. A. Jones

Toronto Builders' Exchange Decides on Amalgamation with A.C.B. & C.I. at Annual Meeting

THE Toronto District Branch of the Association of Canadian Building and Construction Industries rises to replace the old limited organization operating as the Toronto Builders Exchange. For over twenty-seven years the Toronto Builders' Exchange has been a power for good in the building and construction field, but as the city has grown in population, so has the necessity grown for a broader and more comprehensive organization. The splendid pioneer work of the Builders' Exchange will simplify greatly the preliminary work of the new association; in fact, as the situation now stands, the new association will absorb the old one, and from it develop and extend itself along the lines that were so enthusiastically recommended at the organization conference at Ottawa last November.

This decisive step was taken at the adjourned sitting of the annual meeting, on Jan. 27th, and the vote indicated that it was practically the unanimous wish of the members that the proposed amalgamation be carried out without further loss of time.

Presentation to the Retiring President.

At the conclusion of the business up for discussion Mr. Geo. Oakley, on behalf of the members of the Exchange, presented Mr. W. E. Dillon, past-president of the Toronto Builders' Exchange, and Mrs. Dillon, with silver mounted, monogrammed, silk umbrellas. In making the presentation Mr. Oakley referred to the very able and earnest efforts of Mr. Dillon in his capacity as president, also to the splendid results accruing from his almost unlimited amount of hard work and time unselfishly expended for the benefit of the Exchange and its members. This was an opportunity the Exchange was delighted to take advantage of to convey to Mr. Dillon, in some slight measure, a token of the high esteem of each individual member for the indefatigable efforts of the past-president.

Mr. Dillon feelingly thanked the members and disclaimed the credit for the excellent year enjoyed by the Exchange. The honor conferred by the members in electing him to the highest office and the personal pleasure he derived from the work, were sufficient recompense for any of his labor.

Secretary's Report.

The meeting was opened with President A. D. Grant in the chair. The secretary's report was read and was adopted as read. Mr. Kirby congratulated the secretary on the work accomplished in the past year, and referring to the extra office rented by the Exchange, for use as a section board room, which was mentioned in the secretary's report, expressed the opinion that it would be better if all the rooms in the suite were occupied by the Exchange, and not sub-let to tenants as was now the case. In view of the interest now being taken by the younger men, the Exchange was becoming more active and all the rooms of the suite would undoubtedly be required.

Mr. Dillon, in reply, explained that the extra room was secured away from the suite to enable section meetings, if necessary, to be held in secret. It would

not be possible to secure this privacy in the rooms now occupied by tenants.

Mr. Dancy Speaks of Preliminary Work

Mr. Grant called on Mr. Dancy to give the meeting some information as to the organization of the national association. In reply, Mr. Dancy explained that the national association was in its infancy and that the officers of the National Council have had little opportunity since they met at Ottawa to work out the many details. The Toronto members of the National Council had prepared certain schemes relative to the preliminary work, such as the appointment of a permanent secretary, but it would require a general meeting before any definite line of action could be decided on.

Mr. Aldington, of the Trussed Concrete Steel Co., spoke strongly in favor of amalgamation. He pointed out the great advantage of a nation-wide organization, with headquarters at Ottawa. It would enable them to get a hearing and recognition from the Government that would be impossible for them to get as individuals or small independent organizations.

Mr. Geo. Oakley Urges Amalgamation

Mr. Geo. Oakley recalled the Ottawa conference. He stated that the building industries of Canada would be immeasurably stronger by having a parent organization. Concerted effort was always more powerful than individual effort. The local organization would be greatly strengthened and the strength of the local branches would result in a correspondingly stronger parent association. He was not in favor of a highly expensive headquarters organization, but he was greatly impressed with the attitude of the various ministers of the government who had addressed the conference at Ottawa. The association was a large one and carried considerable weight which would be invaluable to them. Another feature, and a most important one, was the bringing in of industries not now members of the Exchange. Heating and plumbing contractors and various other trades were ready and anxious to come in and they would greatly strengthen the association.

Mr. Penn believed that the change of name would not involve any expense or weaken the present Exchange. They would probably be able to operate under their present character.

Mr. Stocker's Motion

Mr. Stocker's motion, presented at the last meeting, was then read, as follows:

Whereas a Dominion-wide Association of building industries has recently been organized for the purpose of dealing more effectively with the vital questions relating to the industry, than is possible through the efforts of local bodies; and

Whereas we believe our definite connection with such an association would not only very materially strengthen its position, but would react in large measure towards the broadening of our local influence, and the stimulating of our local efforts in the attain-

ment of the various objects sought by us as an exchange,

Therefore, be it resolved:

"That the Toronto Builders' Exchange become amalgamated with the said "Association of Canadian Building and Construction Industries" following forthwith upon its adoption of a constitution and by-laws and the granting of its government charter."

Mr. Gander moved the following amendment to Mr. Stocker's motion:

Mr. Gander's Amendment

"That the Toronto Builders' Exchange at this annual meeting do hereby agree to affiliate with the Association of Canadian Building and Construction Industries, representation to consist of—delegates duly elected from this Exchange, who shall have power to vote at any regular or special meeting of that association and our fees in that association shall be one dollar per capita of our membership."

Mr. Teagle seconded this motion.

Mr. Elgie stated he was strongly in favor of Mr. Stocker's motion. In his opinion, Toronto should get away from the petty organization suggested by Mr. Gander's motion. He ridiculed the idea of a one-dollar fee, and pointed out that nothing could be accomplished without paying for it. He did not approve of an extravagant expenditure but he certainly thought they should be reasonable and be prepared to sacrifice something.

Mr. Kirby's Motion

Mr. Kirby moved, as an amendment to the amendment, "That we approve the affiliation of this association with the Association of Canadian Building and Construction Industries, and the President be requested to nominate a committee of seven to bring in a report for the consideration of the Exchange.

Mr. Aldridge suggested that the board of directors take up the question. The various sections should discuss with the directors what the measure would entail. Personally he wanted information as to the benefit to be derived. He thought the members should not be asked to vote blindly.

Mr. Evans of Baines and Peckover, was of the opinion that Toronto should follow Montreal's system of organization so that territory would be opened up, outlying districts would be brought in, and the whole field thoroughly covered. Many were very keen to join the national association who would not join the Toronto Builders' Exchange. If we take in outside members, we cannot retain the name, and in view of the immense benefit to be derived, he considered it good policy to change the name.

Mr. Dillon Wants Information.

Mr. Dillon said that the National Council would meet in February and, in his opinion, it would be wise for the Exchange to wait until after this meeting to enable them to vote intelligently.

Mr. Gander here withdrew his amendment in favor of Mr. Kirby's.

Mr. Oakley expressed the opinion that the Exchange should decide to-day to affiliate or amalgamate. Details could be worked out later. Toronto was particularly well represented at Ottawa and those who attended did not hesitate at the expense they were put to. Toronto was a big factor in the conference, and there was no likelihood of them taking a back seat in the National Association. They would be well able to look after their interests. Decision should be

made to-day. Delay is hurting the movement, and the association will not be as successful as it should be if Toronto delays in making up its mind.

Question of Fees Discussed

Mr. Dancy expressed his regret that all of the members could not have been at the Ottawa conference. If they had, he had no doubt that they would have been as enthusiastic as he was. He said the fee suggested by Mr. Gander was too small. The Exchange had been operating along very narrow lines. Members had individually paid expenses from which the whole Exchange had derived benefit. Personally he was prepared to stand behind the movement and pay his share of the expense involved. Mr. Elgie said Toronto could not afford to be out of the association. If the Toronto delegates to the Ottawa conference had been delegated full powers by the Toronto Exchange, the question would have been settled there and then. In his opinion the other provinces should not control the industry in Canada. Toronto should have its place in the association and the Toronto representatives would protect the other members from exorbitant fees.

Mr. Matthews Wants to be Shown

Mr. Matthews thought it would be unwise to disrupt the present organization and go into a new one of which nothing was known. Personally he never went into a thing blindly. He had to be shown. He was prepared to go into this if he was assured it would be a success and be no excessive burden financially.

The amendment was first voted on and was overwhelmingly defeated. Mr. Stocker's motion was then put to a standing vote and was carried practically unanimously.

Long Roof Girder Forms

The framework of the Garfield Melting Company's foundry at Salt Lake City, Utah, described in Contracting, has 14 70-ft. bents 44 ft. high, each consisting of two reinforced concrete wall columns about 35 ft. high and two pitched rafters. These were cast integral with the longitudinal eaves girders in large wooden forms that were used over and over again and were handled as units by the 70-ft. steel boom of a travelling derrick with wooden stiff-legs.

The heavy form containing each pair of rafters consisted of two inclined wooden troughs each about 40 ft. long, joined together at the apex and connected near the lower ends by horizontal wooden ties braced transversely and diagonally to make, with the rafters, a triangular truss strong enough to resist erection stresses when suspended from the derrick boom by a bridle engaging it near the vertex.

After the rafter forms were seated on the column forms with their open ends connected to the latter, and the longitudinal girder. They were each supported intermediately by four two-post bents of falsework diagonally braced to form towers.

The building was constructed in three successive sections, forms being transferred from one to another and concreted in 11 days for each section. Concrete in the columns, rafters, and girders was placed continuously, making a monolithic structure.

The column forms were filled through telescopic iron chutes and were rammed through successive holes in the sides.

Sherbrooke Builders' Exchange Elect Their Officers

MR. F. W. DAKIN was paid the high tribute of being re-elected president of the Sherbrooke Builders' Exchange, which is associated with and will very likely in a short time compose a branch of the Association of Canadian Building and Construction Industries, during the course of the first annual meeting held in the City Offices. The Sherbrooke Builders' Exchange was launched a short time ago at a meeting called by Mr. Dakin, and since that time the men interested in Canadian industries here have realized the importance of the organization in this period of reconstruction. Owing to the absence of Mr. Dakin, the meeting called upon Mr. H. B. Fletcher to occupy the chair.

Owing to the fact that the time was limited and the meeting very anxious to hear Messrs. J. P. Anglin and Smallpiece, both of Montreal, the routine business was postponed. However, it was decided to hold six general meetings a year, while the officers will meet on the first Wednesday of every month. At the conclusion of the session the members were entertained at dinner by Mr. Fletcher, at the St. George's Club. The list of officers elected, and the lines of trade they represent, follow:

President, F. W. Dakin; vice-president, Mr. Chas. Codere; directors, Messrs. H. B. Fletcher, lumber industry; M. W. Mitchell, hardware; S. R. Newton, steel construction; E. Beauchesne, general contractors; A. R. Wilson, plumbing and heating; Wm. Brault, builders' supplies; W. E. Loomis, brick industry; W. C. Marchant, the painters; A. B. Williams, electrical industry; C. A. Roy, mill work, and G. F. Bradford, plasterers and bricklayers.

A most interesting address was delivered by Mr. Anglin. After speaking of the period of reconstruction, which is now here, Mr. Anglin said that committees had been appointed to study various items and to make things run more smoothly. This was the work of the National Organization, he said. He continued in part, as follows:

"There have been many causes for complaint in the past, and the present method is far from perfect in treating the sub-contractor. As long as a general contractor is forced to compete with other men who are not responsible at quoting figures, the general contractor will have to suffer. If the irresponsible men fail in business, the supply men either have to go to the wall themselves or take it out of the responsible contractor. The motto most heard at the conference was 'A square deal all around.' If the larger contractors get fair treatment from the public it will be an easy matter for them to pass it on. The suppliers of material should give the contractors special conditions. No plan of credit has yet been evolved in the contracting line that seems to work out satisfactorily. Irresponsible men now buy as cheap as responsible ones. There is great room for improvement. By getting together standard systems and standard methods, standard employers' liability laws, lien laws, and building by-laws can be evolved. The labor question is one of the most vital ones, as is realized by every large contractor especially in the last few years. Labor has asserted itself and we all now realize that

in the very near future it will be advisable or obligatory to have agreements with labor. It is felt that a standard agreement across Canada with labor will benefit everybody.

"Under the old organization building exchanges were organized in the chief points. Some are still in existence and others have died out. In some places branches of the Board of Trade handle this work, and in other places the builders were affiliated with the Manufacturers' Association. It is now suggested that the country be organized in local districts in accordance with the main organization. The organization was formed under the name of the Canadian Building and Construction Industries. The Montreal branch is organized and will soon take up the work of the former Montreal Builders' Exchange, and is organized under the same three headings as the main organization. In Toronto considerable difficulty was experienced owing to the length of time that their exchange has been in existence. Besides the main Builders' Exchange, they have the Plumbing and Heating, and the Master Painters' Organizations. Ottawa meets shortly to organize in a similar manner, and we hope that Sherbrooke will soon fall in line and get together and organize into this district all contractors located near Sherbrooke. There is no objection to including men from everywhere. The Montreal Exchange intends to practically annex part of Ontario, as some large contractors from Cornwall and Prescott have signified their intention of joining our district. In order to organize the province, Montreal district may branch out towards Sherbrooke, and also include Three Rivers, which is not yet organized."

Historical Review of Steam Turbine Progress

The Westinghouse Electric and Manufacturing Company has just issued their Circular 1591, entitled "An Historical Review of Steam Turbine Progress." This publication was written by Francis Hodgkinson, whose commercial and engineering knowledge of the steam turbine is, perhaps, as broad as that of any man in America. The circular is a reprint of an article which appeared serially and is now gathered together in one publication, with the intention of becoming a handbook on steam turbine progress. The early history of steam turbine engineering is gone into and the earlier machines installed in America are illustrated. From 1899 until 1917, each year's development is properly recorded as it occurred and the improvements noted. The booklet is profusely illustrated with views of all the different types of impulse and reaction turbines and the construction of blading, valve chamber, governor, throttle valve, coupling and oil cooler are shown in detail. This publication should be a valuable addition to designing and consulting engineers. It is being used extensively, we understand, in the Government training classes for junior engineers on steam engineering work.

At the recent annual meeting of the Manitoba Association of Architects, the following officers were elected for the year 1919: President, R. B. Pratt; vice-president, Chas. Bridgman; secretary, E. Fitz Munn; executive—D. W. Bellhouse, A. E. Cubbidge, L. H. Jordan, H. E. Matthews, A. Melville, G. G. Tetter, J. H. G. Russell.

Good Roads Association Banquet At Winnipeg

A COMPANY of some 350 attended the joint banquet in Winnipeg under the auspices of the Manitoba Good Roads Association and the civic authorities. Mr. S. R. Henderson, reeve of East Kildonan, president of the Good Roads Association, was in the chair, and a feature of the evening's proceedings was the presentation of the provincial trophies and the prizes offered for good road construction during the past season. Sir James Aikins, Premier Norris and other provincial and civic officials, as well as delegates to the Union of Manitoba Municipalities and representatives from other provinces, were guests.

Premier Norris, in an interesting address, spoke of the community of interest that was being developed by the Good Roads Association, and said that the problem was one of the most important now engaging the attention of the people of this country and the United States. There had been a good deal of complaining about high taxes, but roads cost money, and if the burden were distributed over the province every good citizen would join in and help to share the burden. Good roads, the Premier declared, were one of the most important factors in the development of the country. They made transportation easier, and a good road to the elevator was just as necessary as a good road from it.

Ald. Fowler, speaking on behalf of Mayor Gray, who was unable to be present, welcomed the visitors to Winnipeg, and, in regard to the question of good roads, pointed out the disadvantage of this movement as a means of absorbing the spare labor that was likely to be thrown on the market in the next six months or so. He did not urge the expenditure of money merely for the purpose of providing work, but the construction of roads was an undertaking which was bound to be useful and beneficial to a community, and at the same time it would take care of surplus labor.

Sir James Aikins gave a brief address, emphasizing the importance of municipal government. If the government of the municipalities was well conducted the government of the province and the Dominion would also be well conducted, he asserted. The municipalities were the fundamental of the state, and, in their relation to after-effects of the war and the revolutionist ideas, which were being spread all over the world, it would require all the wisdom and energy that had been put into winning of the war to be exercised in order to grapple with the conditions that were facing the country.

The prizes won in the split-log drag competition were presented by Mr. Waugh, being as follows:

Earth class—1st prize, \$50, and the Henry Birk's and Sons shield—Won by J. Lafleche, municipality of Charleswood.

2nd prize, \$30—Won by Archie Turcotte, municipality of Charleswood.

3rd prize, \$20—Won by Hans Hansen, municipality of Rosser.

4th prize, \$10—Won by Thomas Crisp, municipality of Rockwood.

5th prize (special), gold medallion, presented by

Messrs. Henry Birks & Sons—Won by David Reil, municipality of St. Vital.

Gravel class—1st prize, \$50, and the Banfield cup—Won by Atwin Vandal, municipality of West St. Paul.

2nd prize, \$30—Won by W. H. Guest, municipality of Rockwood.

3rd prize, \$20—Won by Klas de Jong, municipality of East Kildonan.

3rd prize (special) \$20, presented by T. R. Deacon—Won by W. J. Harrison, jr., municipality of East St. Paul.

3rd prize (special) gold inscribed watch, presented by Messrs. T. Eaton Co.—Won by W. A. Stewart, municipality of Rockwood.

4th prize, \$10—Won by Richard J. Steele, municipality of East Kildonan.

The judges in the competition were Highway Commissioner McGillivray, W. F. Tallman and A. C. Emmett.

In the province-wide competition, the trophies and prizes awarded by the government were presented by Hon. T. H. Johnson, in the absence of the Minister of Public Works, Hon. G. A. Grierson. The \$25 prize and shield for the best earth road was won by Joseph Lafleche, Charleswood, and in the gravel road competition, Wm. Crichton, of Ellice, won the cup and \$25 prize. The Minister explained that the trophies would be placed in the care of the municipalities, each winner receiving as a personal gift a miniature of the trophy he had been instrumental in winning. The judges in the province-wide competition were Commissioner Waugh, W. F. Tallman and Highway Commissioner McGillivray.

Other speakers were A. Houston, of Regina; W. J. Jackman, representing the rural municipalities of Alberta; Mayor Toole, of Kenora; F. E. H. Luke, president of the Manitoba Automobile Association; Reeve Chapman, Charleswood; Reeve Wroth, Ellice.

Ald. Marion, speaking as head of the Union of Manitoba Municipalities, hoped that as the war was over the scheme put forward by that body for provincial highways would be proceeded with, and Mr. W. H. Carter, of Carter-Halls-Aldinger, Ltd., speaking on behalf of the Winnipeg Board of Trade, of which he is president, urged co-operation between the Good Roads Association and the Union of Municipalities and the body he represented for the promotion of the movement throughout the province.

The engineering trades committee of the ministry of reconstruction which was appointed to compile a list of articles which were not made in the United Kingdom before the war and for which there is likely to be considerable demand after the war, has submitted a report wherein it strongly recommends the extensive adoption of specialization and standardization, especially in the case of small manufacturers, who, it is believed, would do better to confine themselves to manufacturing new types of articles.

The committee recommends that a new industry should not be introduced into the United Kingdom unless the wages paid to the workers therein are such as to ensure an adequate standard of living, or an industry involving any special liability on the part of those engaged in it to industrial disease.

Drainage Methods for Country Roads*

THE first essential feature of an improved road is adequate drainage. It is practically impossible to secure satisfactory results unless this feature be given proper attention. Another prime requirement, wherever a hard-surfaced road is to be constructed, is that a firm and unyielding foundation be provided. The purpose of this article is to supply information concerning the proper methods of draining roadbeds, constructed of various kinds of soils, under different topographic conditions, and also to explain how foundations may be designed to suit the soil conditions, the road surface, and the system of drainage. Since the quality of the soil has such an important influence both on the proper method of drainage and on the proper type of foundation to be employed, it is desirable first to discuss briefly some of the most important characteristics of the different kinds of soils ordinarily encountered in highway construction.

Primary Soils.

The texture and structure are the principal properties of soils that determine the manner in which they should be drained and prepared for road foundations. These are important because of their effect on the permeability and capillarity of soils. For the purpose of this discussion, primary soils may be classified as gravel, sand, and clay; but it should be borne in mind that many of the secondary or mixed soils, because of their more general occurrence in connection with road-building connections, are equally important with these. This is especially true of some of the more clearly defined derivative or secondary soils such as loam, marl, gumbo, hardpan, etc. Where a soil is composed of two different materials, mixed in such proportions that its character is decidedly intermediate, it may be designated conveniently by naming both materials, as sand-clay, sand-gumbo, gravelly-clay, etc.

Clay.

Clay is a soil of very fine texture which results from the complete disintegration of rocks or minerals. Pure clay is very retentive of water and becomes plastic and unstable when wet. It is very difficult to drain, and, on that account, when it occurs in the subgrade of a road, the system of drainage should be designed with a view to preventing water from reaching the subgrade rather than to draining water from the clay. Most clays as they occur in nature contain more or less sand or gravel, which has a stabilizing effect by making the clay more easily drained and by furnishing a combination of mechanically interlocking grains. A mixture containing about 50 per cent. each of clay and gravel or coarse sand often makes an excellent soil of which to construct roadbeds. Such a soil, in addition to being easily drained, has less "capillarity" than clay, and consequently does not need to be drained to so great a depth in order to prevent water rising to the surface. Furthermore, it is moderately stable, even when wet.

Sand.

Sand is made up of granular particles of mineral or stone which occur in nature and which will pass

a $\frac{1}{4}$ -in. mesh screen. Particles which are too large to pass such a screen are called gravel. Nearly all natural sand consists of particles which are composed principally of quartz, individually very hard and durable. There is no coherence between the different grains, however, and soils composed principally of sand are unstable, unless properly confined and protected from undermining, in which case a good quality of sand may make an excellent subgrade for some types of road crusts and for practically any kind of foundation. Sandy soils usually require very little drainage except when the sand is mixed with a considerable percentage of fine silt. Sand so fine and evenly graded that it becomes saturated readily with water and remains so for more or less lengthy periods is called quicksand and has little dependable stability.

Loam.

A mixture of soil composed of clay or sand and a considerable percentage of decayed vegetable matter is called loam. All such soils usually contain both clay and sand in greater or less amount, and the quality of the loam for road-building purposes is largely dependent on the proportion in which the sand and clay are present. Most loams are drained comparatively easily, but are subject to the disadvantage that the vegetable matter they contain may be incompletely decomposed and subsequent decomposition eventually may cause more or less settlement and shrinkage.

Gravel.

Gravel is made up of small angular or rounded particles of stone which occur in nature and which are sufficiently large to be retained on a $\frac{1}{4}$ -in. mesh screen. Gravelly soils are distributed widely in the United States and vary greatly in quality. In general, when a soil contains as much as 40 or 50 per cent. of gravel and sufficient clay or other bonding material to hold the particles of stone together it proves very satisfactory as a material for a roadbed, because it is drained easily and is very stable when compacted.

Marl.

Marl is a clay containing a large percentage of carbonate of lime. Frequently it contains shell fragments and nodules of chalk or silica, and other materials. It grades into calcareous clay on the one hand and into argillaceous limestone on the other, and its quality for road-building purposes varies to a considerable extent. In general this material has few advantages over ordinary clay for use in constructing a roadbed unless the percentage of lime carbonate be sufficiently high to give the material, when compacted, approximately the character of limestone.

Gumbo.

Gumbo is essentially clay or silt containing a high percentage of decayed vegetable matter and a very low percentage of sand. It has a very strong tendency to absorb and hold water, and therefore is hard to drain. If drained properly it may make a fair subgrade on which to place the foundation of a road, but it has comparatively a very low bearing value, and where used as the foundation the design should be such as to give

*Abstract of Bulletin No. 724, U. S. Dept. of Agriculture.

a greater distribution of concentrated loads than is necessary with most other soils.

DRAINAGE.

In the design of a road the drainage structures are planned to take care of water under three general conditions: (1) The rain that falls on the road surface or grade, (2) the rain that falls on contiguous land and flows in accumulated volume toward the road, and (3) ground water from any mediate or immediate source. The structures commonly used to provide drainage and meet these conditions are longitudinal side ditches, usually parallel or approximately parallel to the centre line; intercepting ditches to accommodate water whose approach so close to the roadway as the side ditches is likely to cause injury; lateral ditches or culverts to conduct accumulated water away from or under the road; and subdrains.

The side ditches are primarily to care for water flowing from the road surface and consequently are placed close to the surface or made a part of it, and their use is so general that it is universal practice to incorporate them into the design of the road cross section. If they actually are made a part of the surface, or an extension of it, they take the form of gutters. As gutters, their effect is not entirely the same as when constructed in the form of a ditch, as in the former case they do nothing toward draining the soil of the roadway, while as ditches they frequently reach such effective depth, as the result of cutting and filling along the grade, that they not only serve to carry away surface water but also do more or less toward lowering the water table under the traveled way. In intercepting ditches also are usually approximately parallel to the centre line but are more remote, often being placed outside of grading lines as berm ditches. Not infrequently intercepting ditches, on account of the immediately local conditions, are constructed so close to the roadway that they can be incorporated into the general cross section, but in such cases their design is independent of the other cross-section details, except as limited by them. Extreme cases of this last condition exist when a road is constructed close to a drainage ditch or irrigation canal, or when, as has occurred not infrequently, the spoil bank of such a canal is used as a road grade. In such cases the side ditch is omitted sometimes on the side toward the intercepting drainage ditch, or a gutter design is used and the flow in the gutter frequently turned into the large channel. Lateral or cross drains, whether involving the construction of culverts or not, are to divert the flow from any longitudinal drain into a natural drainage channel. If this diversion involves crossing the centre line it usually requires a culvert. If it does not cross the centre line open lateral ditches are used. Subdrains are used to collect and carry to a suitable outfall water that exists or may accumulate periodically in the soil beneath the road surface or grade. Their use, design, and location depend on the presence of ground water and on the nature of the soil. A retentive impervious stratum underlying a road may prevent the downward percolation of surface water to such an extent as to do injury by saturating the soil, or the presence of springs or other flowing ground water may require their use. In general, subdrains are employed for three purposes appropriate to the conditions existing. They are used to divert springs or confined streams of underground water; to intercept the flow of underground water in the form of general seepage from sources more or less distant; and to lower the water table in places where

the nature of the soil causes such water to rise too close to the surface to permit of securing adequate bearing values in the soil.

These various forms of drainage structures may be grouped into two classes according as they provide for surface or subsurface drainage. Obviously, as between the classes, the distinction is reasonably sharp, although, as pointed out, side ditches sometimes serve to lower the water table; but the distinctions between the various uses of the two types with regard to their respective purposes is often, if not generally, impossible of clear definition. This is true especially of subdrains. No matter what condition has led to the design and use of a subdrain, if occasion arises it may act in all of its common capacities.

Further, these types of drainage structures must be grouped and interrelated so as to produce the effect desired under the existing conditions. The drainage problem, especially as affecting foundations, is essentially a local one. This is apparent in some of the older States where the system of State roads has changes in the foundation design at frequent intervals; and is, of course, doubly apparent from the location and relation of the constantly changing units of the surface drainage system.

In order, therefore, to plan intelligently a system of drainage for any particular road, it is necessary to take into consideration not only the local character of the soil composing the road bed, but also the topography of the adjacent land, the amount and rate of rainfall, and the availability of different materials suitable for use in constructing drains.

Topography has a very important influence in determining the relation of surface and subdrainage, and when one or the other drainage is more practicable. When the topography is such that the side ditches can be given a grade of as much as 1 or 2 per cent., subsurface drains seldom are necessary, except in unusually heavy clay soils and where springs occur; while, on the other hand, where the grade is level or nearly so, subsurface drainage may be required when the soil composing the roadbed otherwise would be comparatively easy to drain.

The topography of the land adjacent to a road determines to a considerable extent also the necessary capacity of the surface drains and the location of the appropriate structures. Watersheds having a fan shape, for example, empty the water which falls upon them into the drainage structures much more rapidly than long, narrow drainage areas, because of the difference in time required for water from the more remote parts of the area to reach the outlet. Steep slopes deliver water at the outlets much more rapidly than flat areas; and impervious soils, by refusing to absorb precipitation, deliver greater percentage of rainfall at the outlet.

The amount and rate of rainfall are the primary factors in determining the quantity of water drained off from the land, or "run-off," as it is called. Since the capacity necessary for a given drain is fixed by the maximum run-off which it will be called upon to accommodate, a knowledge of the rainfall is essential in planning a system of surface drainage. In the design of surface drains and culverts it is usually necessary to consider only the maximum rate of rainfall and the maximum duration of time through which individual rains continue, but in the case of subsurface drains the duration of a wet season and its effect on the accumulation of ground water also may be of importance. During the most extreme local storms occurring in

some section of the United States the precipitation sometimes amounts to 7 or 8 inches in 24 hours, and in a few cases has been known to exceed an inch in one hour. Where the topographic conditions are favorable to a rapid run-off, such as is generally the case with an improved road, from 80 to practically 100 per cent. of the total precipitation may be drained from the watershed during a storm. The extreme rate occurs principally in paved cities in the closely built up business sections, but 80 per cent. run-off may occur in very steep, impervious or compactly shaped watersheds. Under the worst conditions, therefore, it may be necessary to design surface drains and culverts with capacity sufficient to remove about 6 inches of water from a watershed in 24 hours and to take care of an extreme precipitation of about 1 inch in 1 hour. Under other circumstances, the maximum rate of rainfall may be considerably less than that mentioned above, and the maximum run-off during storms may be only about 15 or 20 per cent. of the total precipitation on the watershed, though this low run-off does not apply often to road drainage.

CAPACITY OF DRAINS.

The amount of water required to cover an acre of land to a depth of 1 inch is 3,630 cubic feet. If the maximum rainfall and run-off and the area to be drained can be determined, therefore, the total volume of water which a given drain should be designed to accommodate can be computed readily. From what has been said, it is apparent that any estimate of the run-off necessarily will be a rather rough approximation, and due allowance on the safe side always should be made as a safeguard against possible inaccuracies in such estimates.

The size of drain necessary to carry a given volume of water in a given time may be estimated from the formula $v=c\sqrt{rs}$, in which v =mean velocity of water; r =hydraulic mean radius of the drain; s =the slope of the drain; and c =a coefficient, the value of which depends on the character of the surface of the drain, the slope, and the hydraulic mean radius. Kutter's formula is the one generally considered most reliable for determining the value of the coefficient. According to this formula when English units are used,

$$C = \frac{41.6 + \frac{.00281}{s} + \frac{1.811}{n}}{1 + \frac{(41.6 + \frac{.00281}{s})n}{\sqrt{r}}}$$

in which s =slope ratio of drain; r =hydraulic mean radius in feet, and n =a constant which depends on the character of the surface of the drain. Under average conditions the value of n may be assumed as follows: for open ditches, 0.025 to 0.040; for cobble gutters, 0.020 to 0.035; for concrete gutters, 0.015 to 0.020; for tile pipe, 0.015.

Ditches.

V-shaped ditches have several favorable characteristics. They are not dangerous to traffic. They can be made with a grading machine and can be cleaned and maintained very largely with a grader, or for light work even with a drag. The highest velocity of flow in the ditch cross section occurs toward the side away from the road, and so the tendency to scour or wash, unless there be some disturbing obstruction, occurs first on the side away from the road and gives ample warning

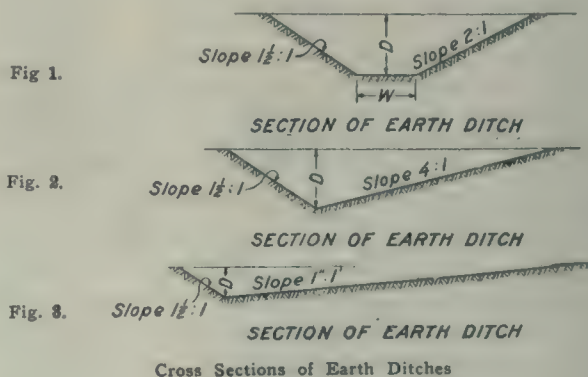
that attention is needed. These are the shapes that most closely approach common gutter design, and thereby lend themselves most readily to continued improvement by paving if the surface be advanced in type to warrant such a change.

Design of Surface Drainage.

Surface drainage systems for roads consist of side ditches along road, paved gutters which are a development of side ditches and replace them, open intercepting ditches constructed to prevent water from reaching the road, and lateral or relief ditches to carry off the water which collects in the side ditches or in the intercepting ditches. Culverts and inclosed drains, which are constructed for the purpose of removing storm water from the side ditches or gutters, are essentially a part of the surface drainage system and are not to be confused with subdrains, which have an entirely different purpose.

Crown.

The amount of crown which the surface of a road should be given in order to drain itself properly is very



important in connection with surface drainage and one of the early elements of consideration in drainage design. But, since this feature is necessarily influenced by other considerations than efficient drainage, it will not be discussed at length in this article.

Side Ditches.

Side ditches usually are necessary where roads are located in cuts, or where they follow the natural surface of the ground. It is also frequently desirable to construct ditches approximately paralleling the road, even when in fill, in order to conduct water from a neighboring cut or berm ditch by a ready channel to some accessible natural drainage line. D is usually made from 1 foot to 1 foot 6 inches, with W sufficient to give the required capacity. Where the ditch is not located sufficiently far from the road to avoid danger to traffic, and the grade is steep, it may be desirable to increase W and diminish D in order to secure the required cross-sectional area and at the same time prevent erosion.

The section shown in Fig. 3 gives a ditch of comparatively small capacity, but the same amount of water flowing in a ditch of this shape will cause less erosion on steep grade than in a very narrow ditch of the cross section shown in Fig. 1. Another advantage of this wide, flat ditch is that it may be constructed easily and maintained by means of a road grader, while the other type of ditches require more or less pick and shovel work. One of its principal disadvantages is that it must be extremely wide on light grades in order to carry any considerable quantity of water, and in

deep cuts it may be very expensive to obtain the necessary width.

Fig. 2 shows a modification of the section shown in Fig. 3, which is intended to meet conditions intermediate between those described as being suited respectively to the other two sections.

For a ditch of given cross section the velocity of flow is dependent upon (1) the quantity of water the ditch carries, and (2) the longitudinal slope of the ditch. The velocity which cause erosion varies considerably with the character of the soil traversed by the ditch, and, since it is impracticable to describe soils in exactly comparable terms, no exact rules can be established for determining the safe velocity for water flowing in earth ditches.

In practice it frequently will be necessary to take into consideration such contingencies as changes in the grade or curves in the alignment of the ditch, or the matter of water being turned into the ditches from intersecting roads or adjacent fields. Where the grade of a ditch flattens out in descending a hill, for example, the velocity of the water will be checked where the change occurs, and a part of whatever soil it has in suspension will be deposited. Curves in alignment produce a tendency for the water to cut sideways, away from the centre of the curve, and for this reason water following along the inside ditch of a curved roadway is very liable to erode the shoulder, and eventually may undermine the road crust, unless provision be made to prevent this. In general, wherever there are marked changes in grade, it is good design to proportion the ditches accordingly, especially where a descending grade flattens out or a curve occurs in the alignment. This is a detail quite commonly neglected, but by observing it the velocity of the flow can be maintained sufficiently uniform to prevent both the deposit of sediment and the erosion of the ditch or grade. The practice of turning into side ditches water from adjacent fields and intersecting roads is very objectionable, especially on steep grades, and usually can be avoided. Where it can be avoided, ample allowance for the additional water should be made in the computations.

GUTTERS.

Where the grade of a road is so steep that the ordinary earth side ditches can not be maintained satisfactorily at a reasonable cost, or where earth side ditches would be unsanitary or appear unsightly, it is customary to provide paved gutters for removing the surface water. The point at which it is economical to change from earth side ditches to paved gutters on account of the steepness of the grade depends on the character of the soil and the amount of water to be carried. The influence of these factors has been discussed under the heading "Side ditches."

The proper type of gutter to employ depends on a number of considerations. Due attention should be paid in its design to having it of adequate size and properly correlated with the other parts of the surface drainage. If a ditch on a steep grade be replaced at some point by a paved gutter, the latter should of course be designed in harmony with the ditch it replaces. If a paved gutter receives a heavy discharge from side roads or elsewhere, the necessary changes should be made to prevent flooding. Often the distance of the gutter from the surface affects its design and type. A gutter paved simply to prevent erosion, and situation perhaps 10 feet from the edge of the surface, does not require the bearing strength of a gutter im-

mediately adjacent to the surface and used often as an effective part of the traveled way. The surfacing material itself sometimes affects the gutter design, inasmuch as principles of harmony and uniformity of surface must be considered; and occasionally proposed methods of construction of the wearing surface affect the design of the gutter. All of these details must be considered, as well as the general ones of available materials and economic cost.

Gutters may be constructed of Portland cement concrete, brick, cobble stones, angular fragments of stone, or other similar material. In some cases they are formed simply by constructing a curb along the edge of the road surface, as is done sometimes in city pavement construction. This method can be employed only where the road surface is made of material capable of withstanding the eroding action of water and where it is not important that the earth shoulders be kept open to vehicle traffic.

Gutters are made from 2 feet to 6 feet wide and from 3 inches to 10 inches deep, depending to a great degree on the type of design, and the size is governed by the same considerations as govern the size of earth-side ditches. That is, they should have a cross section sufficient to drain the road without danger of overflow, and, in order to determine this cross section, it is necessary to consider the area to be drained, the maximum rate of rainfall and run-off, and the character and slope of the gutter.

In designing gutters it is well to bear in mind the following points:

1. It is not usually necessary to extend a gutter entirely to the top of a grade, because, as examples cited indicate, there usually is not water enough flowing in the upper part of the side ditch to cause erosion.
2. It is not usually economical to vary the size of the gutters on long grades so that they will have only the required capacity at all points; but changes may and should be made if any considerable change occurs in the required capacity.
3. All gutters should be sufficiently strong to withstand the impact caused by an occasional vehicle being driven into them, but unless they are capable of withstanding constant vehicular traffic they should be designed so as to discourage the practice of driving into them.
4. The grade of gutters should be made as uniform as practicable in order to prevent them from becoming partially filled by sedimentation, and should not be less than 1 in 200.

Brief directions for constructing the most common types of gutters follow:

Cobble Gutters.

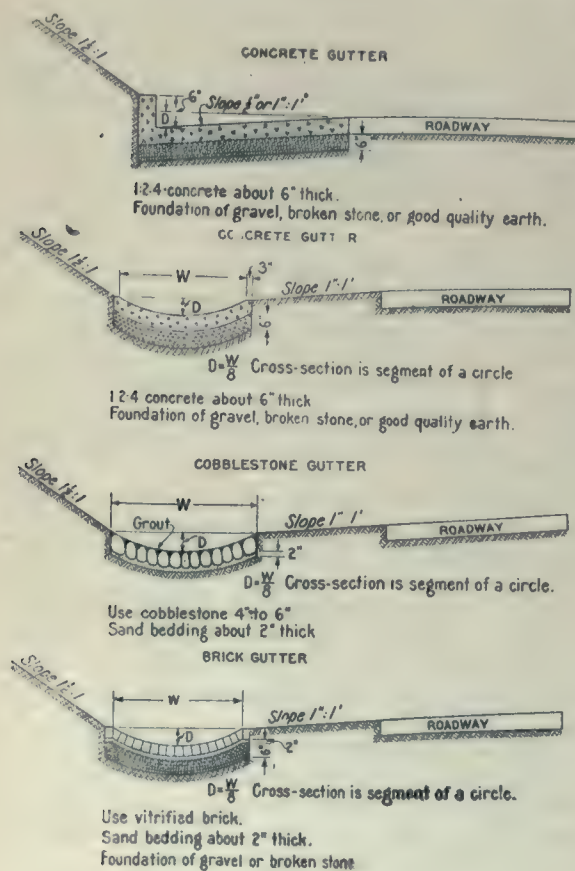
Cobble gutters are ones constructed of rounded water-worn stones, ranging in size from 4 to 8 inches in their longest dimension. The stones should be sound; durable, and fairly uniform in shape. The construction of the gutter should proceed about as follows:

First, excavate a trench to receive the gutter. The trench should have a width equal to the outside dimensions of the gutter and should be excavated to a depth of about 12 or 14 inches below the proposed grade of the gutter.

Second, spread sufficient broken stone or gravel in the bottom of the trench to give a depth of about 6 inches when thoroughly compacted. The broken stone or gravel should be of the kind ordinarily specified for machine or gravel roads, and should be compacted thoroughly with hand rammers.

Third, spread a layer of bedding sand over the founda-

tion to such a depth that when the cobblestones are bedded into the sand and rammed thoroughly, they will form a gutter true to grade, line, and grade in the edges and in the row which forms the lowest part of the gutter. All stones should be laid with their long diameter lengthwise of the gutter and should fit snugly one against the other. Each stone should be rammed until it no longer yields under the rammer, and any irregularities which may develop should be corrected by resetting the affected portions. While the ramming is in progress, sufficient coarse sand should be spread over the surface to keep the joints between the stones well filled. When the ramming is complete, the surface of the gutter should be uniformly true to line and grade. Where-



Cross Sections showing various types of Gutters

ever changes in the dimensions of the gutter are necessary, they should be made gradually, and not by abrupt off-sets.

Fifth, where the grade of a cobble gutter exceeds about 5 per cent., and the volume of water it must carry is at all considerable, the interstices between the stones should be filled with Portland cement grout instead of sand, as above described. A suitable grout for this purpose may be made by mixing together 1 part cement, 2 parts sand, and sufficient water to give the grout a consistency about equal to that of ordinary cream. When the joints are grouted, the bedding sand should not extend above the centre of any stone; because, if it does, the grout is very likely to crack and spall out.

Brick Gutters.

Brick gutters may be constructed in a manner similar to that described for cobble gutters, or they may be made as a part of the road surface, as in the case of the second type of concrete gutter described. They are used seldom on country roads except in connection with brick pavements, and need not be especially discussed here, as the method of constructing the gutters

should not be essentially different from that prescribed for the pavement.

Cost of Gutters.

The cost of constructing gutters varies, to a very great extent and depends principally on the design of the gutter, the construction methods employed, and the availability of materials. The amount of work to be done may also, of course, have an important influence on the unit cost, because this feature determines, in a great measure, the manner in which a force of laborers should be organized for carrying on the work. If the special conditions affecting any particular case are properly considered the following data should afford a fairly reliable basis for preparing cost estimates for the three types of gutters discussed above.

First, consider a cobble gutter of the cross section shown in figure 4, the foundation to be of crushed stone or gravel and the joints to be filled with Portland-cement grout.

Materials required for 100 linear feet:

Foundation, 0.20 cubic yard crushed stone or gravel.

Sand bedding, 0.07 cubic yard sand.

Cobble paving, 0.15 to 0.20 cubic yard cobblestones.

Grout, 0.05 to 0.08 barrel of cement, 0.20 to 0.30 cubic foot of sand.

Second, consider a concrete gutter of the circular section shown in figure 5.

Materials required per square yard of gutter:

Foundation, 0.20 cubic yard crushed stone or gravel.

Sand bedding, 0.055 cubic yard sand.

Paving, 40 paving brick.

Grout, 0.03 to 0.04 barrel cement, 0.014 to 0.16 cubic ft. of sand.

A central purchasing department through which the buying of all the various requirements of the city may be made has been suggested in Toronto. It is believed that in this way better prices can be secured through ordering materials in larger quantities, which is now obtained in lesser amounts by the various departments, and taking advantage of trade and cash discounts. It is also pointed out that it would bring purchasers under closer scrutiny and would increase competition.

At a recent meeting of representatives of various Saskatchewan cities, held in Regina, to discuss the question of the Federal Government's proffered loan for housing purposes, the following resolution, moved by Mayor Hamilton, of Moose Jaw, and seconded by Mayor Bowman, of Weyburn, was passed:

"That this meeting of representatives of the various cities of Saskatchewan endorse generally the housing scheme of the Dominion Government and suggests that representatives of the provincial government and cities meet to draft details in connection with the scheme and to submit same to the cities."

Before deductions for undetermined war taxes, the net profits of the Canadian Car & Foundry Co. Ltd., amounted to \$3,252,608 in the fiscal year ending Sept. 30th last, a new high record in the history of the company. This represented earnings at the rate of 43.3 per cent. on the preference stock. The total surplus carried forward is \$5,830,171.

The annual convention of the Provincial Builders' and Supply Association will be held in Chatham, Ont., during the latter part of February. The exact date has not yet been fixed.

Public School Buildings—A War Problem

By C. B. J. Snyder, M. M. E. N. Y.*

Our attention to-day is directed, as never before, to the word **economy**. Its almost insistent presence is felt each day in practically a thousand different ways, but knowing as we do that it is based upon the needs of the community at large, in carrying forward to a speedy and successful issue the war in which we are now engaged,—we are endeavoring to meet its varying requirements with the utmost patience and good will.

We all know full well that it will be a number of years before there is a return to anything like normal construction costs, and the acute need is, therefore, for architects and engineers to make a supreme effort to meet a part of this increase through economies to be practised in both the design of the work and in the choice and use of materials.

It is well recognized, the author believes, that delay in the production of plans and specifications for any particular piece of work, usually means increased cost, and that speed and perhaps economy is dependent very largely upon the sufficiency or completeness of the data in hand at the time the drawings are to be undertaken, so that once started they may be advanced, with but a minimum of changes.

Economy in design consists essentially of:

In plan, aim to reduce each feature to the minimum of size and to so dispose of the various parts as to eliminate all unnecessary or unused spaces; in other words, to reduce the building to the smallest dimensions that would serve the purpose.

In design of the exterior to obtain a dignified and pleasing appearance, with a minimum of elaboration and ornament;

In materials and form of construction, make use of the least expensive and most easily obtained materials that would answer the requirements, having due regard for permanency and economy of upkeep;

In permitting the contractor the greatest possible latitude in the selection of materials, methods and forms of construction, so as to enable him to take advantage of market conditions and to use those materials and types with which he happens to be most familiar; and

In making the drawings and specifications so explicit that no allowances need be made in the estimates for uncertainty as to their meaning or intent, or that there need be incurred no large bills for extras, an item which in about four and one-half millions of dollars of our work, had not exceeded twenty-six hundred dollars.

It is understood, the author thinks, that the requirements for a building are rigid as to the number and size of class-rooms, together with their equipment of wardrobes and book and store closets; the width of hallways; the width and number of stairways; as well as other items, each of which must be provided for.

Flue Location

A careful checking over of the minimum of space to be assigned to each item, led to the discovery that the lines of vertical vent flues which have heretofore been provided between nearly all the class-rooms in

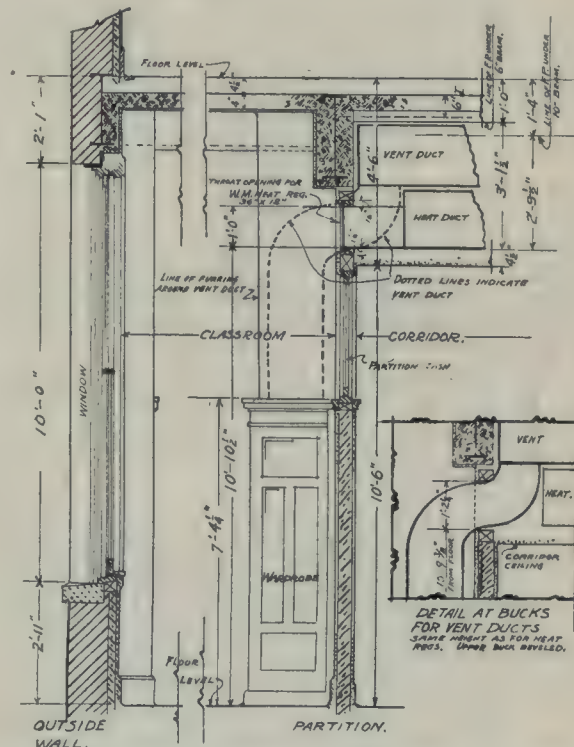
school buildings, could be eliminated, and the vents from the various rooms could be carried above the corridor ceilings and taken up to the roof through trunk-lines located in out-of-the-way corners.

This expedient, which has never before been adopted, so far as is known, has resulted in reducing the length of the typical 49-room building 5 feet 6 inches, and the length of the two wings 2 feet, thus saving a very large amount of floor space and of cubiture.

The omission of the ducts between class-rooms also made it possible to eliminate the usual double partitions, as well as an attic space 4½ feet in height, which was required for the collection of the vents.

It was also found that by providing recesses for steam risers at the sides of the windows, instead of running the risers on the face of the wall the width of class-rooms and of the building was reduced without decreasing the seating or aisle space in the rooms.

A further reduction in the height of the building was obtained by changes in the stair construction. For many years the story height, top to top, of the New York City school buildings, has been fixed at



Vertical sections taken through the outside wall of classrooms, and through the partition between classroom and corridor showing the relation of ducts, partition sash, wardrobe, heat register openings, vent outlet, etc.

15 feet 7½ inches, which seemed to be the minimum height that could be used in connection with the type of double-run stairways which have been found so economical of space.

Stairways

A most exhaustive study of this question revealed the fact that by a change in the construction of stairs enough head-room could be saved to permit of reducing the story height to 15 feet. In a five-story build-

*Abstract from paper read before Municipal Engineers of the City of New York.

ing, this means a saving of more than three feet in the height of the entire building, with a corresponding saving in cubature. It also enables us to reduce the thickness of the outer walls of two stories 4 inches, by placing the building in the group up to 75 feet in height instead of above 75 feet, as determined by the Building Code.

As a result of these changes in flues and stairways, this building contains 203,450 cubic feet less than Public School 93, Borough of Queens, upon which the plans were based, the buildings being alike as to the number of class-room units, the second-floor auditorium, and the giving over of the first floor to play-room and gymnasium and other uses. This very great reduction in cubature reflects one part of the saving that has been made.

Not only did the change in the method of placing the ducts result in a saving in the width and height of the building, but it made possible a better plan for the vents so as to facilitate their ready introduction to the exhaust fan room placed on the roof.

It also renders possible direct economy in construction, since it reduces the amount of partition work,—there being single instead of double partitions between practically all class-rooms, and enables the general contractor to go ahead and finish the partition work without waiting for the installation of the sheet metal, heating and ventilating piping, which at times has caused weeks and months of delay.

The elimination of the many openings through the floor system, customary under the former plans, will very greatly facilitate the use of reinforced-concrete construction, since it will simplify the centering work required.

Test of Economy in Plan

The Committee on Standardization of Schoolhouse Planning of the National Education Association, has for some time been at work on the preparation of a series of rules or standards by which the plan for a school building might be rated by measuring the proportional amount of floor space devoted to different purposes.

These rules provide for the division of the total area of each story of a building into six specified groups, which, together with the standard allowance for each and their application to plans for new Public School 29, are as follows:

	Standard of National Education Association	Public School 29, Brooklyn
1. Walls and partitions	Not over 10 %	10.62%
2. Flues	Not over 5 %	3.51%
3. Stairs and corridors	Not over 20 %	16.17%
4. Accessories	Not over 3 %	0.29%
5. Instruction	Not less than 50 %	57.41%
6. Administration	Not over 12 %	12.00%
	100 %	100%

It is found that the space on the various floors above the cellar, chargeable to administration, is 6.58 per cent. With the standard at 12 per cent. this leaves 5.42 per cent. as the proportional allowance of space in the cellar for the heating and ventilating apparatus and coal storage.

This would be an area of 4,562 square feet, which would be quite sufficient for the purpose, and is probably all that would be needed to be provided, did we not lay out coal storage for at least a year's supply, and that previous buildings on the site all had cellars

to practically the maximum depth, which necessitates carrying our foundations down to at least the same depth and placing a cellar under practically the entire building.

This local condition, while increasing the cost of the building will not add any space which is really available for school use, or that would be provided under normal conditions, such as is contemplated by the standard, and is the reason for arbitrarily fixing 12 per cent. as the proportion for administration work for this building.

Economy of Materials

The exterior design of the building has been so simplified that when it was found that front brick heretofore used could be obtained only after several months' delay (because of the need of the Government for the use of railroad facilities) and at a greatly increased price; the design was readily adopted to use what is known as hard or common brick.

This change represents a saving of perhaps \$4,500 on the exterior brickwork.

The use of limestone has been brought into competition with architectural terra-cotta, at a further considerable saving.

The ornamental work on the exterior has been reduced in quantity and simplified in design as far as would seem to be advisable. It has been the practice heretofore to face the lower part of the walls of the indoor play-rooms with enameled brick, the walls and ceilings above being plastered.

Owing to the extensive use of these play-rooms for basket ball, indoor baseball and other forms of activities, very great damage is being continually done to the plaster work of the side-walls and ceilings, especially where there might be furring or other covering of ducts.

Wall and Ceiling Finish

The present plans and specifications provide that the walls of the first-floor gymnasiums and play-rooms from floor to ceiling shall be of hard brick, cleaned, rubbed smooth with carborundum, and painted.

All hung ceilings, furring of ducts, and plastering of these ceilings, have been eliminated; the soffits of the concrete floor arches, which will form the ceiling, are to be smoothed and painted.

The appearance will, of course, be not as good, but on the other hand these two items alone should eliminate or very largely reduce the expense of future maintenance.

The use of enameled brick has been omitted from the walls of heating chambers and fresh-air intakes, they being finished instead with a coat of cement mortar, smoothed and painted.

Steel plates have been omitted for the division between fresh-air intakes and heating chambers.

Sheet metal has been omitted from the vertical flues, terra-cotta or plaster blocks being substituted. This is important not only because of the saving in cost but also on account of the economy of time required for construction.

Cement has been provided in place of wood or other expensive materials for the floors of auditorium, offices, and of closets containing janitors' sinks.

Floor Covering

Recent advances in the cost of cork tile has made it necessary because of the extremely large percentage of inert material of which it was composed and also

through lack of resiliency. This last consideration, as well as that of sound deadening, is of importance for the reason that the gymnasium (where this floor covering is used) is placed over a portion of the building which may be occupied, perhaps for instruction purposes.

Experiments made with the use of cork carpet have proved to be satisfactory if it is properly cemented down. It has, therefore, been substituted for the cork tile.

Copper gutters and leaders have been omitted from all skylights as not being actually required, while other materials have been substituted for flashings.

Very careful consideration has been given to the item of hardware used on various parts of the work where, in the past, because of low cost, brass or other similar materials have been used very extensively.

The quantity and quality of oak trim has been reduced and provisions have been made, as hereinafter described, for the substitution of other wood for trim and doors throughout the building.

Painting

It would seem also that with the very great increase in cost of painting, varnishing and kalsomining, it would be well to postpone all such work on plastered walls and ceilings until some later time, and, in the matter of woodwork, effect a reduction in the number of coats of varnish from that usually required.

The scarcity of lumber, together with its high price, is quite well understood. An effort has therefore been made to find a substitute for the sleepers and rough flooring which is usually required where wood floors occur. We find that we shall want about 75,000 square feet of this material, and provision is therefore made whereby the contractor, should he so desire, may have a choice of several types of composition nailing material to which the finished floor may really be secured without the intervention of the rough underflooring and the sleepers.

New Type of Cove Base

Frequent delays have occurred in the past in the completion of a building because of the non-arrival from the mills of the cove member of the baseboard,

which is tongued and grooved into the finished floor.

The cove base is absolutely essential from a sanitary standpoint and while we have maintained the present type whereby the wood cove member is tongued and grooved into the finished floor and into the vertical base member above it, we have also provided an alternate in the form of a bent metal cove which can be secured in position after the finished floor and the vertical base are in place. This not only means a saving in cost as between the materials, but will eliminate considerable mill work by doing away with the salient and re-entrant angles.

Interior Finish

Another direction in which the very great scarcity of lumber is felt because of the enormous consumption of all kinds for the Government use is for the interior finish. We have for a number of years been able to obtain western brown ash or plain oak for the trim, except for the auditorium and main entrance halls, which have usually been made of quartered oak. From a canvass of the market at the present time it would appear that the price of both of these materials places them absolutely beyond our reach.

We are advised further that both cypress and white wood are practically out of the market, and that the only material we can count on obtaining in quantity, when desired, and at a reasonable price, is North Carolina or southern pine.

In the stair construction we have worked out a new form of alternate, whereby the contractor may use a cast-iron tread and riser with a non-abrasive surface in lieu of the usual type of tread and riser, consisting of a steel-plate construction with a tread surface of asphalt and a non-abrasive nosing.

Heating and Ventilation

The present Building Code required that every room in every public building hereafter erected, shall be equipped with some approved system of positive ventilating, which during occupancy, will provide not less than two cubic feet of fresh, uncontaminated air per minute for each square foot of floor surface," etc. This practically requires 30 cubic feet of fresh air per



DESIGN SHOWING SCHEME FOR OBTAINING ADDITIONAL LIGHT IN NARROW STREET.
C. B. J. JENSEN, ARCHT.

It is sometimes necessary to erect schools on narrow streets, where the amount of natural light obtained by ordinary vertical walls and windows is not sufficient. This design shows the possibility of increasing the supply of natural light by inclining the walls and windows so as to get more "sky" light.

occupant per minute, which is the accepted standard of practice.

The problem is usually handled on the assumption that the entire building,—that is, the indoor playground, the auditorium, gymnasium and class-rooms,—will all be in use at the same time, the fresh air being supplied by one blower, or if the horizontal distances be very great, then by two blowers.

With the development or increase in the use of our school buildings for social or recreational work, or for purposes of instruction outside of the regular school hours, it has been found that this type of ventilation will not answer the purpose because of the very great waste due to the heating and ventilation of the entire building; when, perhaps only the playground or the auditorium is in use.

In the plans herewith presented the boilers will be run at low pressure while the blowers and fans will be motor driven. The fresh-air supply has been divided into three sections. The play-rooms will have separate blowers to supply air at high temperature, in order to permit of heating in a very short period of time. The auditorium will have an independent blower arranged the same way, while the class-rooms will be supplied with tempered air from a separate set of blowers, the heating, if necessary, being done by direct radiation under thermostatic control.

Smaller Schools

In order to obtain positive circulation exhaust fans are placed in pent-houses on the roof.

Not all of our work consists of the design and construction of large school buildings, since it has been found to be not only desirable but economical to erect small buildings in some of the outlying sections pending their development, which experience has shown to be rather erratic.

In order to be prepared to meet conditions arising a study has been made of smaller types of buildings—2 rooms, 4 rooms, and 6 rooms,—in the effort to provide pupils accommodations absolutely necessary but at the lowest ratio of cubature.

Such an instance might be considered as the design of the so-called "H" type of building, to obtain light and air for a school on an interior plot of limited area rather than on a corner site with its constant and ever-increasing annoyances of street traffic.

Much of the school building work of this city occurs in sections which are being rebuilt, single-family or small houses giving way to the multiple-family or four or perhaps five stories in height. This results in a very large increase of land value, and hence operates against the acquisition of a large school site. The streets oftentimes are very narrow, so that the problem of obtaining sufficient light in the class-rooms of the second and third stories has been very great.

The study of this phase of the subject has led to a design in which the illustration indicates that the upper stories of the facade of the building are inclined to an angle of about 15 degrees from the vertical, so as to permit of the light from the sky being admitted to each room. This may or may not be one of the war problems, but it does present certain economic features as to natural lighting of the interior, which are essential, and seemingly, under the local conditions, can be obtained in no other way.

Independent Roadway Commission Recommended

"Highways" was the subject of considerable discussion at the recent convention of the Union of Manitoba Municipalities. Addresses in regard to the good roads situation in Manitoba were given by Mr. A. McGillivray, Provincial Highway Commissioner, and Mr. S. R. Henderson, of the Good Roads Association. Mr. McGillivray's address contained interesting statistics of construction and expenditures since the passing of the Good Roads Act by the legislature. He pointed out that fifty-one municipalities have taken advantage of the act, and the actual mileage constructed is: Earth, 521.35; gravel, 264.79; and paved, 23.65. The number of bridges constructed totals 320.

The following resolutions, in regard to good roads' legislation and finance, were passed:

That the legislature should appoint an independent commission of three persons to select and officially locate routes for trunk roads; that funds for constructions of trunk roads be provided by the issue and sale of government bonds; that revenue derived under the Motor Vehicle act (less the cost of its administration), should be appropriated for the maintenance of the roads and for the purpose of paying the annual interest accruing on bonds; and that the government should construct and maintain the trunk roads, provided the necessary money can be obtained without interfering with the present good roads funds.

Canadian Trade Summary for 1918

A summary of the trade of Canada for 1918, issued yesterday by the Dominion Bureau of Statistics places the value of Canadian exports for the twelve months at \$1,229,708,244, as compared with \$1,547,340,885 for 1917, and \$1,091,706,403 for 1916. Imports for consumption were to the value of \$906,054,900, as against \$7,005,071,716 in 1917 and \$766,501,512 in 1916.

There was a considerable falling off in the amount of duties collected in 1918, the total being \$154,849,472. In 1917 collections reached \$167,041,330, while in 1916 the customs revenue stood at \$139,002,178.

During 1918 goods exported to the United Kingdom were to the value of \$594,250,690. In 1917 they were valued at \$873,706,892, and the 1916 figures stood at \$709,566,967. Imports from the United Kingdom likewise dropped, being to the value of \$72,879,109, as against \$91,136,728 in 1917, and \$102,956,836 in 1916.

The United States exports to Canada fell below the 1917 figures, when they were to the value of \$828,886,594, as against \$738,142,064 in 1918. In 1916 the United States sold to Canada goods worth \$592,088,039. Canada sold to the United States goods valued at \$433,232,149, which was approximately two million dollars' worth more than in 1917. In 1916 our sales amounted to only \$260,924,864.

Canada's exports to France in 1918 stood at \$101,501,396, or just a little more than one-half of the value of French goods imported in 1917, but almost twice the value of 1916 exports, which was \$55,771,533. Our imports from France were small, being to the value of \$3,754,761, as against \$5,715,770 in 1917 and \$6,371,086 in 1916.

Suggested Solution of Housing Problems

Advanced by British Royal Sanitary Institute

A COMMITTEE, recently appointed by the council of the Royal Sanitary Institute, to consider any simplification of construction and sanitary arrangements that would tend to reduce cost of house building, have completed their report and submitted it to the council. This report was adopted and is of particular interest at the present time, in view of the various housing schemes that are being discussed all over the country.

In the opinion of the committee, it is important, in order to secure good housing, that the number of houses to the acre should be limited. The committee proceed to observe that in laying out a building estate for houses of the character of those under consideration the arrangement of roads and footpaths and their construction are items which have a considerable bearing on the cost of the houses. The traffic upon them is usually light and infrequent, and a narrow road about 12 ft. wide is all that needs be metalled and there should be 5 ft. paths of gravel or tar-paving, separated from the roads by grass borders, making 40 ft. between the fences. Fences between the gardens can be largely dispensed with and privet used to indicate the boundaries. Economy is chiefly to be sought in the selection of the type of house and in the form of construction, though to some extent the cost may be affected by the by-laws of the local authority requiring the employment of unnecessarily expensive materials and involving excessive labour. The Local Government Board has drawn the attention of local authorities to the need of amending by-laws, and it is understood that those now in force are to be annulled and new by-laws substituted.

Standardization Recommended

Standardization is desirable within reasonable limits as a method of reducing cost. For instance, the same plan can be adopted for a large number of houses, with slight modification in the external design to prevent monotony, and also modifications to provide several degrees of accommodation.

Bricks, tiles, slates, piping, taps, baths, sinks, etc., are standardized, and it would be easy to extend such arrangements to items made of concrete, as steps of thresholds, window sills, etc.; also to door-frames and windows in which the sashes or casements might be of one size, there being one, two, three, or four lights.

Staircases.—The adoption of one-storey houses would avoid the necessity of staircases, incidentally leading to an economy of some 12½ per cent. in the cube; and the consequent saving of wood in the stairs as well as joisting and boarding to the first floor. One-storey buildings, without reducing the area of the rooms, cover a very small additional area of ground, which can make practically no difference when the proposed number of houses to the acre is limited.

Bathroom.—The position of the bathroom is of importance as affecting cost. It should be as close as possible to the source of hot-water supply, and preferably on the ground floor in order to save a large amount of piping, and to avoid the use of pressure boilers, with the periodical expenditure for cleansing

and repairs. If the bath is arranged on the upper floor a pressure boiler or geyser is needed to supply hot water, and a good deal of extra expense is entailed for fitting and maintenance. This should therefore be avoided as a measure of economy.

Water Closet.—This should, if possible, open off a well-ventilated back lobby, but where this cannot be arranged, it should open from outside, whether inside the house walls or in an outbuilding. The approach should be under cover and screened from observation.

Food Store.—This should be kept as far away as possible from the water closet or dust place, and be entered from the living-room or lobby, rather than from the scullery. A floor space of about 12 ft. is desirable. The window should face the north or east and extend to near the ceiling, and have inner fly-proof wire gauze and frame, and a ventilating opening near the floor similarly protected. The walls should be rendered smooth in cement and there should be shelves of slate or concrete, and the floor should be of granolithic.

Materials and Construction

Timber Substitutes.—The short supply of timber and its excessive cost necessitates economy in its use, and the adoption of substitutes for which cement concrete, and steel can be largely employed.

Walls.—The adoption of any particular form of walling must depend largely upon the materials that can be obtained in the immediate neighborhood. Where bricks are cheap, it is doubtful whether any other material can compete, but where sand and suitable aggregates are to be obtained, concrete blocks or slabs may prove to be cheaper. They require to be carefully made, and must be submitted to considerable pressure to be satisfactory. Generally it is more economical to obtain concrete slabs for walling from a factory where they can be made under pressure, and of uniform sizes, and supplied of superior make and more cheaply, although the cost of transport has to be added. This argument applies more particularly in the case of a few isolated cottages. A 9-in. brick wall cannot be depended upon to resist driving rain, and must in nearly all cases be rendered outside or rough-cast with cement and sand. Outside walls should be built in cement in the proportion of one of cement to six of sand, and the less exposed surfaces may be left uncovered. Stone walling is not usually so economical as brickwork.

Floors.—The ground floor should be of concrete not less than 4 in. thick, and the proportion may be one of cement, three of sand and six of aggregate, and should be laid on 6 in. of hard, dry core of some kind, such as dry rubble, brick rubbish, or chalk. For the scullery, bath place, etc., the floor should be finished with 1½-in. granolithic. This, however, is not usually considered satisfactory for the living-room. For urban housing this room may be floored with some form of covering laid in situ on a waterproof mixture and composed of sawdust, cement, asbestos, and magnesite, but great care should be taken to keep all metal

away from this material. For rural houses this is hardly suitable, as it would be costly perhaps to lay, and certainly to repair. The better covering is probably some form of tile, laid on 2 in. of well-rolled tar paving in place of the concrete. The floor for an upper storey would in ordinary circumstances be of wood, and it is difficult to suggest any alternative which would effect economy even at the present price of timber. There should be a space about 5 ft. to 6 ft. wide at the back of the house paved with 3 in. to 4 in. of granolithic.

Roofs.—Should be so constructed as to protect the house as far as possible from variation outside temperatures. The pitch should be kept as flat as possible to economize timber. Slopes of 30 deg. are suitable for slates, asbestos slates, bituminous sheeting, or other similar covering. Tiles, however, require a pitch of 45 deg., or thereabout, and heavier woodwork, and are consequently more expensive. The lower pitch with either slates or asbestos slates is suggested. An alternative would be reinforced concrete. Dormer windows, valleys, and internal gutters are to be avoided, as they give rise to considerable expense. Bituminous sheeting and similar materials form good covering, but require attention, and have a shorter life.

Chimneys.—Flues need not be larger than 9 in. square; they should be carried up to at least 3 ft. above ridge, and the top flauched to throw wet off. In exposed positions, the brickwork above the roof should be rendered or rough-cast in cement.

Windows.—The sashes should extend to within 6 in. of the ceilings, and to within 2 ft. 6 in. or 3 ft. of the floor. The glass area should not be less than one-sixth of that of the floor in the living-rooms, and not less than one-eighth in the bed-rooms. Solid frames should be grooved all round, built in, and the grooves thoroughly filled in with cement mortar to form tongues. Casements should open outwards, and fan-lights should be hung at the top. Double hung sashes have some advantages over casements for ventilation. All sashes should be made to open, and due regard be given to the cleaning of the glass.

Plastering.—Ordinary lime plastering with 10 per cent. gauging of Portland cement, executed in two coats is better than any patent plastering, and is also cheaper. Patent plastering is hard, and the character of the surface favors condensation.

Equipment and Fittings

Wood Fittings.—Dressers can be omitted, but there should be shelves in the scullery, and also a cupboard with shelves and hooks. There should also be cupboards in the living-room, and in each bedroom; all should extend to the ceiling. Picture rails should be provided to prevent damage to the walls.

Sanitary Fittings.—The bath should be cast-iron, porcelain, enamelled inside. Economy may be effected in cost, floor space, and hot water by having it only 5 ft. long, which is quite sufficient. An overflow and waste should be provided 1½-in. in diameter. The scullery sink should be of fireclay 10 in. deep, with lifting plug to waste. It is essential and also economical to provide all taps of good quality. The water-closet pan should be of fireclay not less than ¾-in. thick, white inside. The seat should be of deal painted white, both top and underneath, or birch painted underneath and well oiled on top to prevent absorption, and should be hinged. The flushing cistern should be of simple construction, easily actuated, and of good

quality. The use of the above fittings is only appropriate where there is a public water supply and drainage.

Service Water and Cooking Arrangements

Hot Water Supply.—It is very desirable that a supply of hot water should be easily obtainable. It can be provided (1) by a portable washing copper or galvanized iron boiler with draw-off tap; (2) by a range with washing copper attached, and (3) by a range with back boiler and hot-water storage tank. Nos 1 and 2 are simple; the cold water should be supplied through a small cistern, with ballcock ensuring that the water is kept at a proper level in the boiler, and the hot water flows by gravitation into the bath. The height is not usually sufficient to supply hot water to a tap over the sink, therefore, for use at the sink, it has to be drawn off in a vessel. The advantage of No. 2 arrangement is that the fire may be either in the range or under the copper, whichever may be most convenient, while in No. 1 there is no alternative. The third system is necessary where hot water has to be supplied at levels above the range, and involves a pressure boiler and a circulating or storage tank, a considerable amount of piping and periodical attendance in cleaning out the boiler, and possible renewal both of the boiler and the adjacent pipes owing to the deposit of fur. On the ground of both initial and maintenance expense, this system is to be avoided if possible, and in a general way either No. 1 or No. 2 will be found to reasonably comply with all requirements, and preferably No. 2, owing to possible economy of fuel.

Cooking Stoves.—Where gas is available, a gas cooker can be placed in the scullery and a simple register stove with an oven and perhaps a small boiler installed in the living-room. This would be economical in the first instance and tend to economy in fuel. There is a probability that there may be a public supply of hot water within a comparatively short time produced by waste steam from concentrated electricity works, and that current will be supplied at much lower prices, including for power. This may also lead to the more general and economical use of electricity for cooking, and certainly for lighting in urban districts.

Water Supply.—Rain water collection and storage. Where there is a public supply of water, and the water does not exceed 15 deg. of hardness, storage of rain water is not required. When there is no such supply it is desirable to store rain water, which can be best done in a barrel not exceeding 40 gallons in capacity, which can be placed on brick or concrete supports, and if of sufficient height, can be connected with a tap over the sink. A draw-off tap towards the paved yard and a cover should be provided.

Working Conditions

Disposal of Excreta, Rain and Waste Water.—(a) Where sewers are available: Under skillful advice manholes and traps can be largely dispensed with. The overflow from the rain-water butt and the rain pipes should discharge into shoes, without traps. Waste water from sinks, baths and lavatories should discharge into gulleys under the gratings, and one gully should, if practicable, take several wastes. (b) Where isolated from sewers: When there is no public scavenging nor system of water supply, earth closets should be installed and the contents dug into

the land. Where there is a water supply, and arrangements can be made for emptying and cleansing cesspools these may be installed. Excreta from single or double cottages, or in large quantities as from groups of cottages having a plentiful supply of water, could be biologically treated, and the effluent passed into or upon the land, or into a ditch, or temporarily retained in tanks upon allotments for use in dry weather. Waste water from sinks, baths, etc., under favorable conditions, could be passed through a rubble open filter into land drains or a ditch. Or where this is impracticable, could be stored in a cesspool in a garden or allotment, and pumped up for use on the surface. In districts where the conservancy system can be efficiently employed, suitable arrangements must be made for supplying dry earth and for the collection of pails, and, where there is land available, the waste water from sinks, baths, etc., should be collected in an automatic flush tank and discharged in quantities of not less than 10 to 20 gallons at a time into sub-irrigation drains, constructed of agricultural pipes, laid in such a manner that the gradient can be maintained. It is essential that a sufficient quantity of waste water be discharged at each flush so as to make the water travel to the far end of the drains. Without a flush tank the water merely dribbles into the first few pipes and a nuisance is soon created.

Disposal of House Refuse.—The receptacle for temporary storage should be of galvanized iron with a tight-fitting lid, and should be frequently cleansed and dusted with carbolic powder or other disinfectant. House refuse if kept is a favorite breeding place for flies. House refuse contains some materials of value, such as tins, paper, cardboard, bones, bottles, rags, etc., which should, if possible, be separated and sold. The ashes should be screened, the larger pieces used as fuel. In localities where there is no systematized collection by the local authority the house refuse need not be stored, but some of it can be used as food for pigs and poultry, and what is of no use can be buried in the garden as manure. The paper and dry materials can be burnt or sold. Some local authorities recommend the householder to burn all they can in the kitchen fire in order to save cost of collection, but this appears to be a mistake under present circumstances and is sometimes difficult to accomplish, gas fires being used largely for cooking purposes, and these are not suitable for destroying refuse.

Old Houses Should be Kept in Repair

The Repair of Old Houses.—In many districts, especially in manufacturing areas, there is, at the present time, scarcely a habitable house of any size which is unoccupied, and the shortage of houses is so great that under any practical housing scheme the number of houses completed in each of the three following years will only make up the shortage and not leave a house vacant. To supply the ordinary "give and take" of people who require to move from one district to another, there ought always to be a certain percentage—say between 5 and 10 per cent.—of houses unoccupied, so that it would be five or six years before it would be safe to demolish any of the existing houses. During the whole of this time temporary repairs must be done to old houses without entertaining the question of their condemnation. Speaking generally, as regards the rural districts of England as a whole, every house ought to be repaired

and kept in as good condition as possible during the next ten years, because it will be impossible to build, except at a high price, and materials will, for all those years, be difficult to obtain. The only house condemnations which should be considered are those where the surrounding conditions make it impossible to keep them fit for occupation.

Readjustment of British Industry to Peace Conditions

MR. F. G. KELLAWAY, parliamentary secretary of the Ministry of Munitions, in a statement to the representatives of the press on November 29th, predicted that British manufacturers would turn over to peace conditions more readily than they did to a war footing. To weigh this statement it should be realized that from the date of the organization of the Ministry of Munitions to the last month of the war, aircraft production increased sevenfold, machine-gun production thirty-sevenfold, and other munitions proportionately. The record of British factories in adapting themselves to the output of munitions of war has been a remarkable achievement. Their return to peace production, if even more effective, as predicted, will fully demonstrate the enterprise, adaptability and determination of British industry.

Manufacture of Toys, Furniture, Locomotives, Cream Separators, Needles, Etc.

As showing what is actually being done in the way of readjustment, Mr. Kellaway cited a number of reports which had come in to the Ministry of Munitions. In the munitions area of Hebburn-on-Tyne a firm previously engaged in the manufacture of aeroplanes is turning over to the manufacture of heavy toys and furniture, giving employment to 500 people. A Newcastle-upon-Tyne firm from producing aeroplanes is turning over to household-furniture making, and will give work to 500 people. Another firm in the same town is changing from guns to the building of locomotives, a new industry, which will find employment for 5,000 people. A firm at Burnley which was manufacturing fuses, is turning over to the manufacture of electric fittings. At Leigh, in Lancashire, a firm is going to produce presses for brickmaking, and it is estimated it will employ about 1,000 persons. A Sheffield firm is turning over from the manufacture of shells to files and springs, and expects to employ 1,000 persons. At Leeds one firm will cease to make steel pressings for mines and copper bands for shells and make dairy utensils, while another which was engaged in assembling aeroplanes will devote its buildings to the making of iron valves as an adjunct to their brass valves department. One Birmingham firm is changing from the production of fuse components and aeroplane parts to the manufacture of motor accessories, and another from aeroplane parts to capstan lathes. At Matlock a firm is arranging to manufacture cream separators, which are now largely imported from America and Sweden.

Three munition firms at Leicester, Ilkeston, and Nottingham are taking up the manufacture of hosiery needles, which in prewar days were practically entirely imported from Germany, and they hope to turn out a million, and later on two millions a week. Three Loughborough firms are devoting themselves entirely to the manufacture of hosiery, bearded needles, heretofore imported from Germany. A Leicester firm

which before the war was engaged in importing typewriters and selling and repairing them, now proposes to manufacture them. Another firm in the same town which formerly made vulcanite pressings for magnetos will now make fountain pens, which were imported from America before the war. A third Leicester munition firm is laying out plant for producing hose-suspender fittings, which in pre-war days were almost wholly imported from Germany. Two other firms in Leicester are going to manufacture corset steel, and wood wool from old pit props. The latter occupation will be conducted in the foundry where iron shells were cast for the war. Then there are several cases where manufacturers who were producing aero engines are going to make engines for motor cars; and another firm of a similar character is going to turn out motors for small launches. In another case a firm is changing from tank and shell making to boot machinery; and in South Wales tin can firms are in position to begin civil work immediately, but are prevented from doing so at present owing to the difficulty of obtaining supplies of tin plates.

Waterproofing Concrete

THE problem of making concrete waterproof is one that has interested every construction man and structural engineer in the business—many engineers and specialty manufacturing companies have devoted a great deal of time and study in experimental work, but in the minds of many there appears to be some doubt as to the success of the results achieved and the permanent effect on the strength of the concrete of the various materials or compounds mixed in the aggregate.

Unfortunately the majority of waterproofing materials mixed in the aggregate, do result in a reduction of the compressive strength of the concrete. In the Engineering Review, a general discussion on the present knowledge of the subject was presented in an interesting way. It was stated that a water-tight concrete will be obtained without the addition of special preparations if the following points are observed:—

- (1) Adopt a sufficient proportion of cement.
- (3) Mix the concrete fairly wet, and mix it thoroughly.
- (4) Place the concrete carefully and lay as much as possible at one operation.
- (5) If joints are unavoidable, clean and roughen the old surface, wet it thoroughly and coat with a layer of neat cement paste before laying the new concrete.

The amount of cement required to produce a watertight concrete depends on the nature and size of the coarse aggregate; for small aggregate up to about $\frac{1}{2}$ inch a mix of 1:1:2 or 1:1½:3 should be used, but with coarser stone up to 1½ inches a mix of 1:2:4 should be satisfactory. Tests made by Taylor and Thompson in the U. S. show that a percentage by weight of water to total weight of dry material of 7 to 8 gives the lowest permeability, greatest strength, and greatest density.

In work of any magnitude it is well worth while to have permeability tests made upon various mixes in order to obtain the most economical mix to give a watertight concrete for given materials.

Special Treatments

The special treatments in use may be divided into surface treatments and mixture treatments. Surface

treatments have on the whole been found to be ineffective. Good results have been obtained by successive applications of hot solutions of 2 ounces of alum per gallon of water and $\frac{3}{4}$ pound of castile soap per gallon of water; the alum solution was worked in with a stiff brush and followed immediately by the hot soap solution, both washes being maintained at a temperature of 100 deg. F.

In another case successful results were obtained by cleaning the surfaces of the concrete and applying paraffin with a paint brush, the paraffin being then driven in with an oil blow lamp.

Two of the most successful mixture treatments consist in the addition of hydrated lime and of soap and alum solution. Hydrated lime tends to reduce the size of voids in the concrete and gives the mortar the property of flowing more easily into place; good results have been obtained with 5 per cent. to the 15 per cent. of the weight of the cement. Unslaked lime should never be used.

Another treatment consists in a mixture of an alum and soft soap solution of the strength previously referred to.

The general conclusion is that if specific treatments are necessary in any particular case, it is an indication of faulty materials or proportioning of the concrete; such treatments will always be more expensive in the end than proportioning the cement accurately so as to obtain a dense concrete.

The whole "snag" in concrete work is that builders and architects have as a rule not the slightest idea of the fact that if anything like successful results are to be obtained from concrete great attention must be paid to mixing both as regards accurate proportions and thorough manipulation.

If initial care is taken to have the materials tested, most of the troubles with concrete will disappear.

Concrete Oil Tanks

Storing oil in concrete tanks is a new departure in England. A tank with a capacity of about ten gallons was recently made with a chemically treated concrete aggregate, and after being allowed to "weather" for seven days after moulding was filled with paraffin oil. Thus filled it was placed in a shed, where it remained for fifteen weeks; at the end of this period it was carefully examined. With the exception of evaporation, no loss had taken place; there was no sign of leakage, and the outside walls of the tank were free from the smell of the contents. Upon removal from the pot on which it had been standing no trace of paraffin could be detected, nor had the underside of the tank acquired any smell. This is probably the most severe test that could be applied to any container.

The Engineering Index, the standard index to engineering periodical literature, has been acquired by The American Society of Mechanical Engineers, and hereafter will be compiled and published by that Society. The first issue of the index, under its new management, appears in the January number of the Journal. As heretofore, The Engineering Index will be regularly issued in three different forms: (1) As a part of the Journal of the Society; (2) As a separate monthly publication for libraries or individuals desiring to clip the items for indexing purposes; (3) As an annual volume in which all the items for the year are collected.

Ontario's Coal Importation

The great increase in the importance of coal into Ontario from the United States during the last fifteen or twenty years, and its undesirability from a local and a national standpoint, were pointed out by Mr. C. A. Bogert, retiring president of the Toronto Board of Trade, in his annual address. "In the fiscal year ending June 30, 1900," said Mr. Bogert, "1,075,441 tons of anthracite and 2,362,115 tons of bituminous coal were imported into Ontario, as compared with 3,362,322 and 12,983,000 respectively, in the fiscal year ending March 31, 1918. The situation is undesirable from a local standpoint, and also in a wider sense, as it necessitates so large an item of imports from a country with which our adverse trade balance already is of unweildy proportions. And further, it would be of incalculable advantage to our Province if sources of fuel from within our own territory could be developed. Canada's vast coal fields, because of their distance from Ontario's industrial centres are not, as far as we are able to determine, available to us on an economic basis. It would appear, therefore, to be of first importance that every encouragement be given to private and public efforts to develop domestic fuel resources, and to displace the use of imported fuel with that produced locally. At present under official auspices experiments are being carried on with a view to the utilization of Ontario peat. Assured of your concurrence, I also urge that our Government take further steps for the preservation of our forest resources, otherwise one of the most important of our Canadian assets is in danger of gradual depletion."

Mr. VanScoyoc Addresses Publicity Assoc.

Speaking before the members of the Montreal Publicity Association on Friday, January 24th, at their weekly luncheon, Mr. H. S. VanScoyoc, advertising manager of the Canada Cement Company and formerly chief engineer of the Toronto & Hamilton Highway Commission, gave a very informative talk on this important construction enterprise, which was illustrated by moving pictures, loaned by the Ontario Government.

In the course of his talk Mr. Van Scoyoc made reference to the extension of Toronto's market area, which had been greatly increased through the means of better roads. In comparing the amount of traffic over the highway in 1914 and 1918 when it was completed, the proportional increase amounted to several thousand vehicles in the year. Some interesting figures were given by Mr. Van Scoyoc, which showed a greatly increased traffic. In 1914, 525 vehicles passed a given point as compared with 5,764 in 1918. This increase was also noted in automobiles, with 262 in 1914 and 4,429 in 1918.

Outside of providing a better means of transportation for the farmer for his marketable goods to Toronto, there was noted a great improvement in citizenship, initiated by better roads.

A bill for amending the Montreal city charter is to be submitted to the Quebec Legislature by a number of private citizens. This will alter the system of administration, and provides for the appointment of a technical committee, composed of civic engineers, the chairman of which would be the chief engineer, and the members of which would remain in office during good behaviour and could be dismissed only for cause.

Mainly Constructional

East and West—From Coast to Coast

It has been proposed by the Mayor of Moosomin, Sask., that an electric light plant be constructed in that town during the current year.

An iron trades council has been formed, representing pattern-makers, machinists, boilermakers, blacksmiths, electrical workers and other kindred trades.

An extension of the Blindman Valley Ry. for a distance of eight miles from Bentley to Larson, is likely to be one of the new projects to be brought before the Alberta Legislature at its coming session.

It is rumored that provincial stockyards are to be located at Prince Albert, Sask., and that as an immediate result a new meat packing plant will be established and the line of the C.P.R. run into the city.

The Ontario Government is to call for tenders immediately for the construction of that portion of the provincial highway lying between Ottawa and Prescott, a distance of 50 miles, taken over last summer.

It is reported that the district north of London, extending to St. Marys, is to be the scene of considerable drilling activity. Drillers are already seeking oil in various sections and a large area of land is under option.

The Dominion Government proposes to construct a new lighthouse on Triple Island, off the British Columbian coast, according to an announcement by Lieut.-Col. W. P. Anderson, chief engineer of the Department of Marine.

An invitation was given the members of the Building Trades League, Toronto, recently to become affiliated with the Building Trades Department of the American Federation of Labor. The question was referred to the unions affiliated with the League.

The L'Air Liquide Societie has taken out a permit in Vancouver for the construction of a \$25,000 plant at the corner of Yukon Street and Fifth Avenue. The principal purpose of the plant is the manufacture of liquid air, but oxy-acetylene gas and calcium carbide will also be produced.

The officers elected by the Building Trades League, Toronto, for the coming year are: President, D. A. Weber; vice-president, Mr. Jenovies, Bricklayers' Union; secretary, W. R. Bank, Engineers; financial secretary, W. J. Storey, Plumbers' and Steamfitters; treasurer, Sam Garland, Laborers.

It is reported that the Grand Trunk Railway is about to undertake the reconstruction of its yards at London, the work to include the removal of the principal shunting area to the extreme east end, where a large territory is available with no street intersections. Plans have been prepared for the laying of 25 lines of tracks, it is stated.

A deputation of representatives of the legislative and municipal officials in the district affected recently waited on the Saskatchewan government to urge that it use its influence with the Federal authorities to have a railroad line run from Regina to Avonlea and south 18 miles from that point and thence west about 30 miles, through the Dahinda district to connect with the Gravelbourg line.

Notice has been given that the C. P. R. will apply to the Government for authority to build six branch lines in Saskatchewan and one in Alberta. The latter is to be from Duchess northward. The Saskatchewan extensions are as follows: From Archive to Wymark, from Fortune south-east for eighty miles, from Lenigan to Cumberland House,

from Leader to Big Stick Lake, from the Weyburn-Sterling branch southwesterly, and from the Manitou Lake branch northwesterly to Whitford Lake. Other railroads are also making application for power to extend, including the Western Dominion Railway Co., the Athabasca and Grande Prairie Ry. Co., and the Northwest Route, Ltd.

It is stated that two new railways will be built shortly into the new region of the Ungava in Northern Quebec. Petitions for the incorporation of companies to construct these roads will be filed at the present session of the Legislature. One will run from St. Felice, Lake St. John, to Petit Sikapu, and the other from Seven Islands, North Shore, to Lake Manikek, in the far north.

Municipalities in the eastern and southern parts of the Province of Saskatchewan are desirous of having a railway built to run from Estevan north to The Pas, passing through Soughton, Kipling, Broadview, Melville and Yorkton. A deputation recently visited Regina to take the question up with the provincial government and it is also to be brought to the attention of the Federal authorities.

London, Ont., intends to take its part in providing work for returning men. The construction of 45,000 sq. ft. of pavement has been proposed as a commencement by City Engineer Brazier, as soon as weather will permit. More than 160,000 sq. ft. have been authorized since August, 1914, but the work has been held up owing to war conditions. Another important undertaking which has been brought up for consideration is the West London sewer system, to cost \$200,000.

While the machinists' union in Toronto has declared in favor of a six-hour work day, other unions are not acquiescing with the idea. The officials of the Building Trades League are in favor of a five-day week, eight hours a day, in preference to the other proposal. The Carpenters held a union meeting in Montreal recently at which a resolution was unanimously passed calling for an eight-hour day, and this eight-hour day has already gone into effect.

The British Columbia Government has decided to take advantage of the Dominion Government's housing loan, of which that province's share amounts to \$1,000,000, and will arrange immediately for the initiation of a scheme in this connection in South Vancouver. To this end an order-in-council has been passed providing that certain lots situated in that municipality, recently acquired by the Government, will be granted to returned soldiers, and that steps will be taken for the erection on each homesite of a suitable dwelling.

In connection with the proposed sewer system for West London, City Engineer Brazier will recommend that two systems be laid, one to carry off the storm water and the other for sewage. Another point to be taken up is that of a pump to raise the sewage to the level of the trunk line that will carry it to the disposal plant at the cove. Plans are being prepared for the installation of one at the corner of King and Thames Streets to take care of the sewage from Penman's new factory, and also of that from three or four sewers that now empty directly into the river between King and Ridout Streets. If the council intends proceeding with the work in West London this year, Mr. Brazier will advise that the pump be installed in West London. This would take care of all the sewage in that district as well as that which it is proposed to pump into the sewer at the corner of King and Thames Streets now.

The Dominion Government is organizing labor bureaus at Halifax, Amherst, Truro, New Glasgow, Sydney and Glace Bay, in Nova Scotia; at Moncton, Newcastle, St. John and Fredericton, in New Brunswick; and at Charlottetown, P. E. I. In Ontario there are already fifteen or sixteen such bureaus in operation, and the West is being similarly organized. Mr. Bryce M. Stewart, Chief Statistician of the Department of Labor, recently visited Winnipeg in con-

nection with the establishment of a government clearing house in that city, and the organization work in the western provinces has been placed in the hands of Mr. Thomas Molloy, of Regina, secretary of the Saskatchewan bureau of labor. The government's object is to co-ordinate all the agencies for the re-establishment of the returned soldiers in civil life, and it is urged that unless employers patronize these new offices, and secure their help through this channel, they cannot be efficient.

According to the statement of Hon. Arthur Meighen, Minister of the Interior, at a Board of Trade banquet in Winnipeg, recently, it is the intention of the government to expend \$20,000,000 on public works and \$60,000,000 on railways during the coming year. Of the appropriation for public works, \$12,000,000 is to be used for buildings, and about \$6,000,000 on rivers and harbors, leaving about \$2,000,000 for minor work, such as roads and bridges, and monuments. Of the \$12,000,000 for public buildings, \$5,000,000 will be expended on new construction, and \$7,000,000 on repairs and maintenance. Half of the amount set aside for the railways will be used for the building or purchase of equipment, including 4,000 freight cars, and the balance is to be expended on betterments and new construction. The new construction will be confined almost wholly to the completion of branches on which work had previously reached an advanced stage and had been held in abeyance owing to the war. No absolutely new ventures are to be undertaken in connection with the railroads.

Personals

Hon. T. H. Johnson, attorney-general for Manitoba, has been elected president of the Jefferson Highway Association. The Jefferson Highway extends from Winnipeg to New Orleans and it is planned to make it a first class automobile road for the entire distance. The association has been invited to hold its annual meeting next July in Winnipeg, and it is probable the invitation will be accepted.

Mr. C. A. Bogert, retiring president of the Toronto Board of Trade, does not consider there are very great prospects of development in the shipbuilding industry in Canada. In his annual presidential address recently, he said: "Shipbuilding conditions in this country do not compare favorably with those prevailing in either Great Britain or other European centres. The enormous tonnage being launched all over the world will soon overtake the demand and, with rates decreasing in consequence returns on the original investment of capital will be wholly inadequate. Let us hope that conditions may so change that our shipyards will eventually be able to operate on a basis that will be reasonably profitable."

Obituary

Mr. F. W. Pennock, who for the past eighteen months has acted as electrical engineer to the Imperial Munitions Board, has rejoined the R. E. Clegton Company, Montreal, whose business has recently been incorporated under the name of Cleaton Company (Canada) Limited, and will act in the capacity of general manager.

A very large circle of friends in Vancouver and district received with lively expressions of sorrow the news that William A. MacLennan, local manager of The Steel Company of Canada, Limited, had died at Montreal, on Sunday, January 12, from pneumonia, following influenza. Mr. MacLennan, who had gone east to attend a convention of company managers, was 62 years of age; he leaves a widow, who accompanied him on his trip East, and a sister, Mrs. Fiddler, residing at Toronto. He was born at Whitby, Ont., and had been a resident of Vancouver for about 18 years.

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Government Shipbuilding Curtailed—What is the Reason?

IT is reported that Sir Thos. White has stated to those engaged in the shipbuilding industry that no more contracts for ships would be awarded by the government. But in spite of this statement it is also said that fifteen contracts for ships have been awarded by the Government since the armistice was signed. What is the explanation of this situation? The Government states that these contracts had been arranged for but not finally let, before Nov. 11. It was also said that the Toronto shipyards were filled to capacity with orders. This latter statement does not appear to be substantiated in any way, as some of the shipyards have cut their staff of workmen and are contemplating a complete shutdown. Canadian-built ships have been giving a good account of themselves both in the hull and in the machinery construction, and if ships are needed, why not Canadian ships?

It is possible that the Government does not care to commit itself to a state-owned ship policy, but it must be admitted that ships are badly needed, or will be long before they can be built, and it would appear to be the part of wisdom to prepare for this de-

mand now, and at the same time render assistance to many shipbuilding companies who are contemplating dismantling their plants and going out of business. We cannot see established industries go by the board without feeling that some one has blundered. Here we are faced with a problem of finding employment for thousands of workers, and in view of the Government's expressed intention to proceed with necessary construction work in order to meet the labor crisis, this sudden halt to the shipbuilding programme appears to be inconsistent. From the standpoint of employment alone the Government should proceed with its shipbuilding programme. We have to find work for our unemployed.

The construction of two wooden steamers, for instance, according to the recent statement of the manager of a large shipbuilding industry, would provide work for upwards of six hundred mechanics for about ten months or a year, and it would be difficult to find a better investment for the Government or one more certain of showing satisfactory returns. It is evident too, that few undertakings offer so much labor employment for a similar expenditure.

The shipbuilding industry is facing a serious situation and in our opinion the Government should take immediate steps to see that sufficient contracts are let and are evenly distributed so that every yard in the country will have its share of the work and thus be in a position to provide for its quota of the unemployed. The demand for shipping in the near future, if not at this very moment, will be greater than the supply, and if the government does not want to operate these ships when they are constructed they would find a ready sale for them to private corporations.

Road Building an Economic Safety Valve in the Present Crisis

ANOTHER industry, in a class similar to the shipbuilding industry as a labor absorber at a comparatively low capital expenditure, is road building. There is scarcely another industry in which the percentage of labor cost is so high as in the construction of roads.

That good roads have become a vital necessity in Canada was fully evidenced at the recent convention held in Ottawa under the auspices of the Eastern Ontario Good Roads Association. Urgent as is the need for good roads in Canada, more urgent is the need, and immediate need, of employment for our rapidly increasing army of unemployed. The government has placed itself on record as favoring the expenditure of public money on necessary public improvements in order to mitigate, to as great an extent as possible, this serious situation. In roadway construction we have a most necessary public improvement in which an exceedingly large percentage of the money invested will be spent in labor. It would appear to be difficult to find a more suitable public improvement, all things considered, for the Government to undertake.

During the recent Good Roads Convention at Ottawa, the Hon. J. D. Reid, Minister of Railways and Canals, stated definitely that Government financial aid for the building of roads would be forthcoming. What percentage of the cost would be assumed by the Government would have to be determined later by parliament, but in view of the fact that this is the first time the Government has committed itself to this policy, it is very gratifying, and we trust that the efforts

of all interested in good roads as well as those interested in the unemployment problem will spare no effort in getting the programme under way at as early a date as possible.

Fifth Annual Conference of County Road Superintendents and Engineers to be Held in the Parliament Buildings, Toronto, March 3, 4 and 5

THE date of the Fifth Annual Conference on Road Construction for County Road Superintendents and Engineers, under the auspices of the Ontario Department of Public Highways, has been fixed for March 3, 4 and 5. Next to the benefit derived from personal experience is that obtained from association with others engaged in the same work, meeting like conditions, and confronted with similar problems. In the improving of highways this is particularly true. The end striven for by all is the same, namely, smooth, hard, attractive roads, the cost being commensurate with the service rendered. The means whereby this end is reached vary widely. Traffic conditions in different localities are not the same; soil and climate are not uniform over extended areas; still greater differences are found with respect to natural materials available for road construction, all of which necessitate variation in the methods of construction.

In order that those engaged in the improvement of Ontario's roads may discuss the numerous phases of the work in which they are engaged the Department has arranged for them to meet in annual conferences. Owing to the close relationship which exists between the county and township road superintendents and the engineers of the Department of Public Highways in connection with the administration of the highway laws of the Province, it is evident that such meetings prove invaluable in carrying out a general scheme of road improvement. Uniformity of method and organization throughout the Province is desirable as far as possible, and to this end it is advisable that the engineers of the Department be familiar with conditions in the counties and townships, and that the superintendents and engineers should know the views of the Department.

The subjects on the programme will be introduced by short addresses from engineers and superintendents who are familiar with the topics on which they speak. Each address will be followed by a short, informal discussion, with a view to securing an interchange of ideas among those present. Since the benefit to be derived is in proportion to the amount of discussion and the numbers taking part, each member should come prepared to ask questions, to describe past experience, and should consider himself personally responsible for the success of the meetings.

In addition to a large supply of lantern slides, the Department has made a series of motion pictures illustrating different phases of road construction and the laying of various types of surfaces. These pictures will be used in connection with the discussion of the subjects with which they are connected.

Every county and township road superintendent and engineer is strongly urged to attend all sessions of the conference. Past experience has shown that each meeting brings forth discussions in which every road builder should be interested.

The conference program is outlined as follows:

GOOD ROADS CONFERENCE PROGRAM

MONDAY, MARCH 3RD

2.00 p.m.—**"Road Foundations, Drainage and Culverts."**

Geo. Hogarth,

Engineer of Highways, Ontario Dept. of Public Highways.

Discussion introduced by:—

John M. Young, County Road Supt. of Wellington.

U. W. Christie, County Engineer of Dufferin.

"Earthwork and Grading."

A. R. McVicar,

County Road Superintendent of Brant

Discussion introduced by:—

S. McClure, County Road Supt. of Carleton.

L. A. Pardo, County Road Supt. of Kent.

TUESDAY, MARCH 4TH.

10.00 a.m.—**"Ontario's Highway Organization."**

C. R. Wheelock

County Engineer of Peel.

Discussion introduced by:—

G. R. Marston, County Engineer of Norfolk

"Rock Excavation, Quarrying and Crushing."

J. R. McQuigge,

County Road Superintendent of Renfrew.

Discussion introduced by:—

R. H. Fair, County Road Supt. of Frontenac.

E. R. Blackwell, County Engineer of Leeds and Grenville.

2.00 p.m.—**"Snow Fences and Snow Removal."**

S. A. Commeford,

Chief Engineer, Toronto-Hamilton Highway Commission.

Discussion introduced by:—

T. V. Anderson, County Road Supt. of Lennox and Addington.

Charles Talbot, County Engineer of Middlesex.

"Permanent Road Surfaces"

R. C. Muir,

Asst. Engineer, Ontario Dept. of Public Highways.

Discussion introduced by:—

D. T. Black, City Engineer of Welland.

P. Robertson, County Road Supt. of Lincoln.

WEDNESDAY, MARCH 5TH.

9.30 a.m.—**"County Road Accounts."**

K. W. McKay,

County Clerk of Elgin.

Discussion introduced by:—

H. D. Cleminson, County Road Supt. of Pr. Edward.

D. W. McBurney, County Road Supt. of Haldimand.

"Specifications and Contracts."

E. A. James,

Engineer to the Toronto & York Roads Commission, Toronto

Discussion introduced by:—

J. G. Cameron, County Road Supt. of Dundas, Stormont and Glengarry.

W. W. Brookfield, County Road Supt. of Welland.

2.00 p.m.—**"Stone and Gravel Road Construction."**

J. G. Wilson,

County Road Superintendent of Halton.

Discussion introduced by:—

H. G. Bleecker, County Road Supt. of Hastings.

Wm. Watters, County Road Supt. of Lanark.

"Road Maintenance."

F. A. Senecal,

County Road Supt. of Prescott and Russell.

Discussion introduced by:—

T. R. Allison, County Road Supt. of Wentworth.

G. F. Pineo, County Road Supt. of Elgin.

Annual Meeting of Ontario Good Roads Association, March 5, 6 and 7

The annual meeting of the Ontario Good Roads' Association will be held in Toronto, March 5, 6 and 7, immediately following the Conference of County Road superintendents and Engineers at the Parliament Buildings. This is the seventeenth annual meeting of this association.

Test of a Flat Slab Floor, Western Newspaper Union Building at Chicago, U.S.A.*

By Arthur N. Talbot and Harrison F. Gonnerman

THE Western Newspaper Union Building, an eight-story reinforced concrete structure located in Chicago, was erected in the spring of 1909, and had been in use by a printing company until 1916. The floor tested had been occupied by printing presses.

Two types of floor construction were used in the building. The first five floors were slab and girder type; the sixth, seventh, and eighth floors were Turner mushroom flat slab type (four-way reinforcement). The floors of the building were divided into panels 17 ft. 5½ in. by 19 ft. 4½ in. The test was made on the sixth floor. This floor was designed for a live load of 250 lb. per sq. ft. and was nominally 8½ in. thick. In general, the thickness was greater away from the columns than in the vicinity of the columns. The interior columns were octagonal in form, 24 in. in short diameter below the floor tested and 21 in. in short diameter above it. After the test was made, the floor was broken into and the location and extent of all laps and the position of reinforcing bars with respect to the surfaces of the slab were found. Fig. 1 shows the arrangement of the reinforcement found over the test area, including the position of the laps.

The concrete in the slab was 1-2-4 mix; in the columns 1-1-2 mix was used. The coarse aggregate was

from 3,500,000 to 5,100,000 lb. per sq. in. When the floor was broken up after the test, a noticeable difference was found in the quality of the concrete in the four test panels.

Steel coupons were cut from reinforcing bars at different places in the tested floor. The bars gave an average yield point by drop of beam of 63,600 lb. per sq. in. and an average ultimate strength of 101,300 lb. per sq. in.

The Test

The method of testing was similar to that used

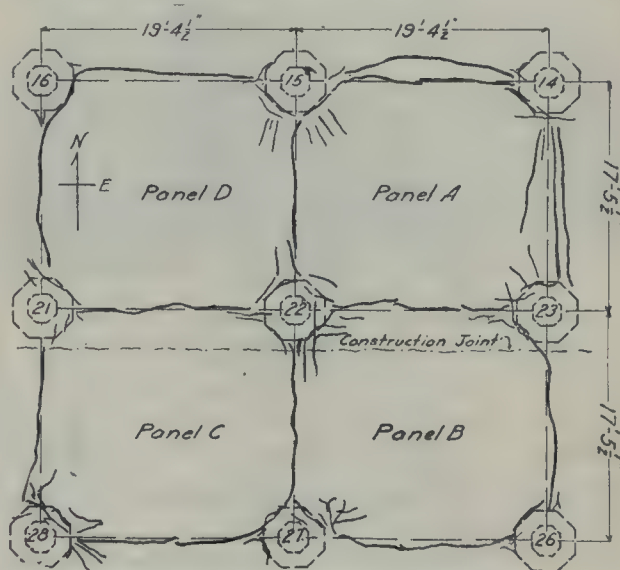


Fig. 2. Location of main cracks in upper side of slab

in previous buildings tests. The loading material was pig iron. The pig iron was hauled from the freight yards to the building in auto trucks. The net weight of each truck load of iron was obtained by weighing on a certified scale before it was hauled to the building. At the building the pig iron was loaded on hand trucks, hoisted to the test floor by means of an electric freight elevator, and then placed on the test area by hand. A record was kept of the number of truck loads placed on each panel and the total weight on each panel was obtained from the truck weights.

Cracks in Slab

It was noted before the load was applied that there were numerous checks in the upper surface of the slab in the regions around the column and along the panel edges. Most of these were evidently surface checks; others were tension cracks formed under previous loads. The latter opened upon the application of load. Fig. 2 gives the location of the more important cracks on the upper side of the slab which either opened or formed under the test load. These cracks were all open cracks—much more marked than hair cracks. Under the load of 913 lb. per sq. ft. they ranged in width from 0.02 to 0.06 in. These cracks show the regions of high tensile stress in the top of the slab. The main cracks at the columns were generally at or near

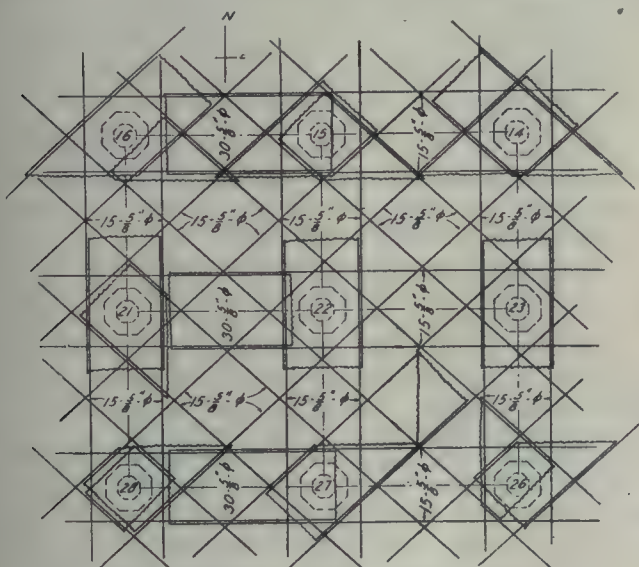


Fig. 1. Arrangement of reinforcement in test area

gravel. At the time of the test the building was eight years old. Pieces of the concrete were cut out from the floor and sawed into test prisms approximately 5 in. square and 16 in. long; one face of the prism was coincident with the upper surface of the slab. The concrete was taken from parts of the slab which had not been highly stressed and which was relatively free from reinforcing bars and cracks. The strength of these test prisms ranged from 3190 lb. per sq. in. to 5460 lb. per sq. in. and the initial modulus of elasticity

*Abstract from Bulletin No. 106, issued by the University of Illinois.

the edges of the column capital; they branched out to join the cracks extending along the panel edges between the columns. The cracks at the capitals of the columns bordering the loaded area were fully as wide as those at the capital of the central column. The cracks along the panel edges were generally as pronounced as those around the capitals.

Fig. 3 shows the location of the more important cracks on the lower side of the slab in panels A and C, the panels in which the principal tension gauge lines on the lower side of the floor were placed. In panels B and D, in addition to those noted in the figure, there were cracks over the panels in positions similar to those noted in panels A and C. In panel D the cracks were not so wide nor so numerous as in the other

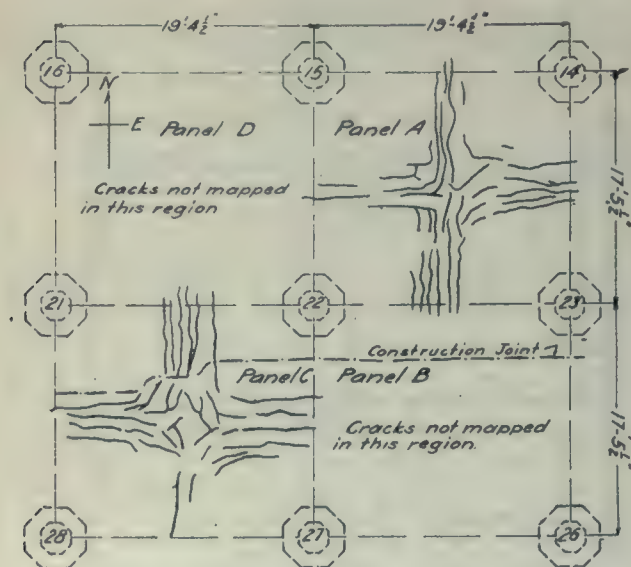


Fig. 3. Location of main cracks in lower side of slab

panels, even at the maximum load. Panel B had larger and more numerous cracks than the other panels. Most of the cracks on the lower side of the slab were found in bands extending in rectangular directions. In a small area at the panel centres cracks extended in diagonal directions. In a small area at the panel centres cracks extended in diagonal directions. No cracks or checks had been noted on the lower side of the slab before loading was begun. The first hair cracks here were observed at a load of 234 lb. per sq. ft. At a load of 425 lb. per sq. ft., the cracks were fairly well defined and for higher loads they gradually opened up and extended. The main cracks on the lower side of the slab did not open so much as the main cracks on the upper side of the slab. The construction joint opened appreciably under the application of load.

Upon the removal of the load the cracks closed, giving the slab an appearance similar to that which it had before the load was applied.

The stresses in the east and west rectangular band at column 22 averaged about 41,400 lb. per sq. in. The stresses in the north and south rectangular band at column 22 ranged from 23,700 lb. per sq. in. at the edge of the column capital to 40,500 lb. per sq. in. at gauge lines near the edge of the band on either side of the column. The bars in this band were lapped at column 22; the bars ending about 80 inches north and south of the column centre. It will be noted that at

the gauge lines near the edges of the rectangular bands the stresses were greater than in bars at the middle of the band. In bars outside the loaded area and near the edge of a rectangular band stresses were found as great as 6000 lb. per sq. in. It is evident that portions of the slab outside the loaded area contributed measurably to the resistance developed in the slab.

Stresses in Reinforcing Bars in Lower Side of Slab

On the lower side of the slab the greatest stresses were found in the bars of the rectangular bands. At the maximum load stresses from 24,300 to 30,000 lb. per sq. in. were observed in rectangular bands within the loaded area. In the one which had 30 bars instead of the usual 15, stresses from 18,000 to 21,000 lb. per sq. in. were found.

The stresses in the rectangular bands at the edge of the loaded area varied from 5,100 lb. per sq. in. in a bar outside the loaded area to 22,500 lb. per sq. in. in a bar inside the loaded area. At one gauge line outside the loaded area and near the edge of the band a stress of 15,600 lb. per sq. in. was found.

The stresses in the diagonal bands in the region of the centre of the panels were smaller than those in bars of the rectangular bands in the region between columns. The stresses in diagonal bars at gauge lines away from rectangular sections which pass through panel centres ranged from 6,300 to 18,300 lb. per sq. in.

The effect of position of reinforcing bars with respect to surface of slab on the stress developed is discussed in another place.

Strains in Concrete

On the upper surface of the slab the greatest compressive strains were found at gauge lines along the inner panel edges midway between columns. Strains from 0.00089 to 0.00097 in. per in. were observed at these gauge lines. Assuming a modulus of elasticity of concrete of 4,000,000 lb. per sq. in. and a straight-line stress-strain relation the stresses in the concrete corresponding to these deformations would be 3560 and 3880 lb. per sq. in. Strains as great as 0.00054 in. per in. (corresponding stress in the concrete on the assumption just given, 2160 lb. per sq. in.) were found at gauge lines at the panel centres.

The greatest strains in concrete on the lower surface of the slab were found close to the edge of the capital of column 22. The strains at this column at the diagonal gauge lines ranged from 0.0012 to 0.0016 in. per in. at the maximum load. These strains are as great as the strains which were found at failure in the tests of the concrete prisms cut from the slab; they represent the range in deformation at the ultimate load usually found in compression tests of concrete. Spalling or chipping of the concrete surface was plainly visible near the edge of the capital of column 22 in panel A. At rectangular gauge lines near the capital of this column a strain in the concrete of 0.0014 in. per in. was observed. These high deformations indicate that the concrete near the capital of column 22 was highly stressed and that at certain gauge lines it was stressed to its ultimate strength, the action of the surrounding concrete preventing its complete failure.

Near the edges of the capitals of columns bordering the loaded area strains from 0.00054 to 0.0011 in. per in. were observed at diagonal gauge lines, and strains from 0.00044 to 0.00081 in. per in. at rectangular gauge lines. With a modulus of elasticity of concrete of 4,000,000 lb. per sq. in. the stresses correspond-

ing to these strains would range from 1760 to 4400 lb. per sq. in.

Resisting Moment Accounted for by Stresses in Reinforcing

It will be of interest to find the magnitude of the resisting moments developed in sections of the slab and to compare the values with the bending moment due to the external forces. As the part played by the tensile stresses in the concrete is unknown and uncertain, only that part of the resisting moment found by using the measured stress in the reinforcing bars can be considered. The resisting moment based on the tensile stresses in these bars may not be expected to account fully for the bending moment. The two sections considered will be (1) a section across the panels midway between columns, and (2) one along an edge of the panels parallel to the first section but skirting the part of the periphery of the column capitals at the corners of the panels. It will be noted that the edges of the area here considered are along lines of zero shear, except around the column capitals. The external forces acting on the row of half panels are the load on the two half panels and the reaction or external shear at the three column capitals. The moment of the couple formed by these two external forces will be resisted by the numerical sum of the resisting moments developed in the two sections. The moment of the internal stresses at the section of the panel midway between columns is referred to as the positive resisting moment and that at the edge of the panel as the negative resisting moment. The actual distribution of these resisting moments along the sections need not be considered in making the desired comparison.

Analysis shows that, for a uniformly distributed load, and round columns, the value of the bending moment for a load two panels wide is given quite closely by the equation

$$M = \frac{2}{8} W l_1 \left[1 - \frac{2}{3} \frac{c}{l_1} \right]^2 \quad (1)$$

for sections at right angles to the long way of the panel, and

$$M = \frac{2}{8} W l_2 \left[1 - \frac{2}{3} \frac{c}{l_2} \right]^2 \quad (2)$$

for sections at right angles to the short way of the panel where

M = bending moment for a width of two panels

W = load on one panel

l_1 = long side of an oblong panel measured from centre to centre of column

l_2 = short side of an oblong panel measured from centre to centre of column

c = diameter of column capital.

With the load of 913 lb. per sq. ft. over four panels, the bending moment for a width of two panels, as obtained by equations (1) and (2), is 12,820,000 lb.-in. for the long way of the panels (resisted at north and south sections) and 11,060,000 lb.-in. for the short way (resisted at east and west sections).

The positive moment (the resisting moment at the section across the panels midway between columns) and the negative moment (the resisting moment at the section at the edge of the panels) together must resist this bending moment. With a condition of ends of slab for which the tangent to the curve of flexure at the edges of the panels remains horizontal when the load is applied (usually termed fixed ends), the condition assumed in the analysis, the positive moment will be found by analysis to be one-third of the total resisting moment and the negative moment two-thirds, provided the slab is uniformly stiff throughout. If the tangents at the panel edges deflect somewhat, the positive moment will be greater than one-third and the

negative moment less than two-thirds. In the comparisons to be made it will be assumed that the proportions given by analysis are one-third for the positive moment and two-thirds for the negative moment. As stated, calculations of the resisting moment developed at sections of the slab at the boundaries of the loaded area as accounted for by the observed stresses in the reinforcing bars, the results of analytical determinations of the moments at sections at the edges and at the middle of the loaded area, and the amount of flexure in the columns all go to show that there is little inaccuracy in this assumption in the case under

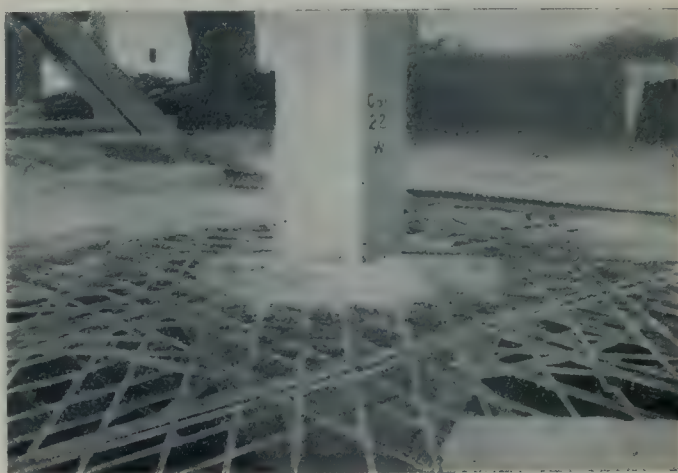


Fig. 4. View showing arrangement of reinforcing at Column 22

consideration. The analytical value of the positive resisting moment will be termed the analytical positive moment and that of the negative resisting moment the analytical negative moment. For the north and south sections the magnitude of these analytical moments became 4,270,000 and 8,550,000 lb.-in. respectively, and for the east and west sections 3,700,000 and 7,400,000 lb.-in. respectively.

In the calculation of the resisting moments developed, lapped bars were considered as contributing to the resisting moment wherever the bars extended beyond the section a sufficient distance to insure adequate anchorage with respect to the magnitude of the stress developed in the bar. Many of the laps were made in such a way that the additional section may not be expected to contribute much to the resisting moment. As measurable stresses were found in bars near the edge of the band outside the loaded area, they were taken into account in the calculations. The ring rods around the columns and the column bars which were bent out into the slab were not included in the reinforcement, for no measurements of strain were made on these bars. For the diagonal bars the component of the stress was taken in a direction at right angles to the direction of the panel edge. The average of the stresses at the principal critical gauge lines was generally used. For the bands at the edges of the loaded area the stresses were considered to vary over the band from gauge line to gauge line. Some judgment had to be used in determining the stress variation as well as the availability of lapped bars, but it is believed that the assumptions made give results well below the actual resistance developed in the slab. It should be noted that the maximum stresses observed in bars of negative moment were 15 per cent. greater than the average of the stresses used in computing

the resisting moment accounted for by these stresses, not counting bars in bands near the edges of the loaded area, and similarly the maximum stresses in bars at sections of positive moment were 25 per cent. greater than the average of the stresses used in computing the positive moment. The measured position of the bars with reference to the face of the slab and the measured thicknesses of the slab were used.

The reinforcing bars are not the only source of tensile resistance in the slab; tensile strength of concrete assists. It is evident that at sections of positive moment tension in the concrete may make up a considerable part of the resistance offered by the slab, and even at sections of negative moment it may have an effect. This tension will be especially influential in regions away from cracks. At points of the sections which are outside the loaded area and where the stresses in the bars are small it may be expected to form a not inconsiderable part of the total resisting moment developed. Of course, if all panels were loaded, the effect of tension in the concrete would be much less, since its greatest proportional effect is outside the loaded area.

Time Effect of Load and Recovery upon Removal of Load

As has been stated, two or more sets of strain gauge and deflection readings were generally taken after an increment of load had been applied,—the first set immediately after the last of the load had been placed and another set 12 hours thereafter. A third set was taken 66 hours after the load of 913 lb. per sq. ft. had been applied.

The effect of time on the strains in the steel and concrete was very small; the reading in a few of the gauge lines increased slightly after 12 hours, not more than may be considered to be within the error of observation. This was true for both steel and concrete even in the most highly stressed places at the maximum load after a period of 66 hours had elapsed.

The deflection readings were affected but little through the 12-hour period until a load of 637 lb. per sq. ft. was reached. At the maximum load the increase in deflection through the 66-hour period was small.

Four days were consumed in removing the load. Four hours after the last of the load was removed, readings were taken on the gauge lines and deflection points, and twenty hours later another set was taken. The cracks in both upper and lower surfaces of the slab had closed so that they were not easily traced. The recovery at the centres of the panels was about 75 per cent.; at other points it was generally greater. The recovery in strains in steel and concrete was also large. Even where high stresses and open cracks had been observed the residual strain in the steel was not more than that to be expected from the lack of interlocking of particles at the cracks. In the region of high compressive stress in the concrete the recovery at the principal gauge lines was 75 per cent or more; in the reinforcing bars the recovery averaged about 80 per cent. In general the action of the slab was that of concrete of high quality.

General Comments

Although there were differences in the stresses and deflections found at corresponding points in the four loaded panels, these differences can generally be accounted for by (1) difference in the arrangement and number of the reinforcing bars, (2) differences in position of the bars with respect to the surfaces of the

slab, and (3) differences in strength and stiffness of concrete in the four panels. The large amount of steel in the region of the column capitals bordering the loaded area (where there were two or three bands lapped) added greatly to the stiffness of the slab in this region. The effect of this added stiffness was to cause higher relative stresses to be developed at the columns bordering the loaded area, and relatively large negative resisting moments were developed at columns where lapped bars were numerous. Another effect of the lapping of bars at columns and in certain of the rectangular bands was, to decrease the deflection of the slab in the panels affected by the laps. Higher stresses

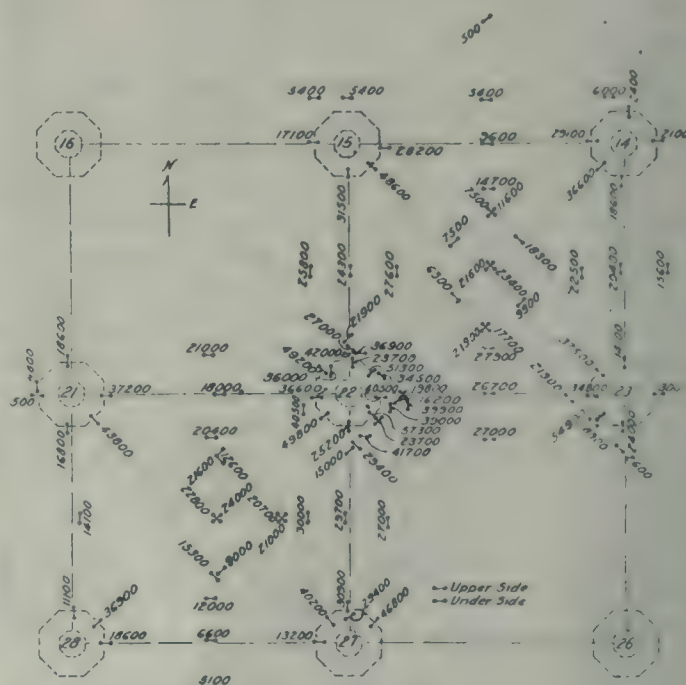


Fig. 5. Stresses in reinforcing bars in pounds per sq. in. at load of 913 pounds per sq. ft.

in reinforcing bars and greater deflections in the slab were found in the panels for which the compression tests showed weaker and less stiff concrete. Cracks, also, were wider and more numerous in these panels. It is apparent that the tensile resistance of the concrete at sections of positive moment, particularly near the outer edges of the loaded panels, contributed to the resistance of the slab even at the maximum load.

Although the nominal thickness of the slab ($8\frac{1}{2}$ in.) was less than that required by building regulations, the slab fulfilled the common requirements for compressive and shearing stresses in concrete of the high quality shown in the tests of prisms taken from the slab. The provisions of the Joint Committee on Concrete and Reinforced Concrete for bending moments and working stresses in concrete of 3,000 lb. per sq. in. strength give a thickness about the same as the designed thickness of the slab.

Summary

The following deductions have been drawn in the foregoing presentation of the results of the test:

(1) The tests of samples of the concrete from the slab, as well as the hardness and toughness of the concrete observed in breaking up the slab, indicate that the concrete was of unusually good quality, and that it had high strength and stiffness.

2. The position of the important cracks on both

upper and lower sides of the slab may be expected to indicate the region of high tensile stresses in the reinforcing bars; it is also an indication of the general action of the slab in flexure. The cracks on the upper side at the load of 913 lb. per sq. ft. opened to a width of 0.02 to 0.06 in.; those on the lower side were not so wide. Upon removal of the load the cracks closed, leaving the surfaces of the slab with the appearance which they had before the load was applied.

(3) For reinforcing bars in the upper side of the slab in the regions of negative moment, the stresses in bars of diagonal bands were greater than those in bars of rectangular bands, a stress of 57,300 lb. per sq. in. being observed in a diagonal bar and one of 42,000 lb. per sq. in. in a rectangular bar at the maximum load.

(4) For reinforcing bars in the lower side of the slab in the regions of positive moment, the stresses in bars of rectangular bands were greater than those in bars of diagonal bands even though the former were farther above the lower surface of the slab than the latter; in the one apparent exception, the presence of laps doubled the usual number of bars.

(5) On the upper surface of the slab the greatest compressive strains were found at gauge lines along the inner panel edges midway between columns, ranging from 0.0009 to nearly 0.001 in. per in. at the maximum load; at the centres of the panels values about half as great were found. On the lower surface the greatest strains were found at the middle column; these ranged from 0.0012 to 0.0016 in. per in., values which are as great as the strains found at failure in the tests of the concrete prisms cut from the slab and as great as are ordinarily found in compression tests of concrete at the ultimate load.

(6) The observed stresses in the reinforcing bars accounted for about 90 per cent. of the analytical negative moment and about 70 per cent. of the analytical positive moment, as given by the methods used. It should be noted that the observed stresses used are average stresses over the gauge length, and the stress at a crack may be expected to be greater than the average over the gauge length. It may be noted that the sum of the positive and negative moments accounted for by the measured stresses in the reinforcing bars has almost the same value as the sum of the positive and negative moments recommended by the Joint Committee on Concrete and Reinforced Concrete, and that the negative moments so accounted for are about 113 per cent. and the positive moments about 73 per cent. of the moments recommended by this committee. In making a comparison with methods used in designing it should be borne in mind that the principal maximum stresses were from 15 to 25 per cent. greater than the average stresses which were used in computing the resisting moments accounted for by the stresses in the bars; in designing, a uniform stress over the section is assumed.

(7) The action of the floor slab under test should give added confidence in the suitability and reliability of the flat slab as a load-carrying structure.

Hydrated lime was recently written into the specifications for the new Turkey Creek concrete sewer to be erected at Kansas City, Mo., to cost \$1,100,000. There are 47,367 cubic yards of 1-2-4 concrete with $7\frac{1}{2}$ per cent. of hydrated lime. Approximately 1,000 tons of hydrated lime being required.



Col. C. H. Mitchell, C.M.G., D.S.O.

President Falconer has just announced the appointment of Col. C. H. Mitchell as Dean of the Faculty of Applied Science & Engineering of the University of Toronto. Col. Mitchell's administrative ability has been one of the outstanding features of the war. He is still in France and will not reach Canada until about the middle of May, when he will immediately take over the duties of his new position, succeeding Dean Ellis, who retires on pension. His appointment will meet with universal approval.

Among other economic discoveries in Germany is a process for making a cement substitute, worth while noticing. It is claimed that common building lime is so treated that it has the same quality as cement in hardening in water. The new material has been extensively used in smaller residences, has been found much cheaper than cement, and, if reports are correct, seems to prove a valuable and cheap substitute for cement.

The executive of the Provincial Carpenters of Alberta recently despatched a telegram to the Acting Premier, Sir Thomas White, informing the Government that there are 200 carpenters idle in Calgary, 150 in Edmonton, 40 in Medicine Hat, 45 in Lethbridge, and many more throughout the province. They made a direct enquiry as to what the government proposed to do to give these workmen employment.

A plan has been suggested by Sir Sam Hughes for the erection of a national memorial, at the expense of the country at large, in every county or municipality for Canada's war veterans and war victims.

The Bridge Engineer and the Architect

By Frank Barber †

AN article appeared in your journal in its issue of November 6th last, on "Reinforced Concrete Bridges and their Architectural Treatment," by Mr. F. G. Engholm, and the present writing is in response to a request by the editor that the writer discuss Mr. Engholm's article.

Most pontists will agree with Mr. Engholm's remarks as to decorative surface treatment of concrete by exposing the aggregates. Some will go farther and condemn the smooth mortar surface which has been used so extensively by nearly all bridge engineers (including the writer) as generally unsuitable. The color of cement mortar is cold, drab and dirty. Moreover, it is not a "true" finish. The mortar which has been spaded to the surface and rubbed smooth is only skin deep and gives a poor indication of concrete which consists for the most part of sand and stone.

The writer warmly approves Mr. Engholm's desire that the bridge builder should make use of subdued color effects as was done in many great architectural works in times past. This may be attained, for instance, by exposing the aggregates, mentioned above, and by the use of burnt clay products which Mr. Engholm also approves.

However, it would be difficult to reconcile every day experiences with some of Mr. Engholm's statements. I shall not try to controvert his statement that "the use of masonry for bridges must now be regarded as a thing of the past." It would be too cruel.

Mr. Engholm attempts to show why, as he says, the majority of designers in concrete fail to create anything worth while, as follows:

1. "Their inability to understand the scientific and working spirit of concrete.
2. "The lack of that knowledge to furtherance of thought in terms of concrete.
3. "The impossibility of abandoning the knowledge they have already acquired in building with other materials."

Mr. Engholm adds that "with the perfect knowledge of these three points a thing of beauty will result"; and again, "there are still those first three points which should stand and in themselves create a beautiful bridge."

I have turned these statements upside down and inside out. Finally I have turned all negatives into positives, and I believe this probably improves them somewhat. Nevertheless how a designer with their aid alone can produce a beautiful bridge is more than ever I can discern. I make this confession well aware that I thus lay myself open to the charge of a lack of understanding.

But whether or not Mr. Engholm has happily conceived in the above three points, the "Three Lamps of (Concrete) Architecture" is not what chiefly interests me. These could be discussed to better advantage and with more authority by an architect. His article, though differing in material, is not very different in purpose from articles which have appeared from time to time upon the general subject of the aesthetics of bridge design. In such of these writings as I have in mind, it is generally said that too little attention has

been paid by bridge engineers to aesthetics, and some rules for their guidance are formulated, and cuts are given of what are said to be beautifully designed parapets, piers, etc. Sometimes these have been damned by faint praise and again they have been hailed as timely articles filling a long felt want. At the end of a chapter on aesthetics (Chap. LII., Vol. 11, Bridge Engineering) J. A. L. Wadell mentions some of the best of the literature of this subject.

Probably little fault can be found with most of the statements made in the writings above mentioned, but the very appearance of these articles, generally written by engineers and purporting to show in short space how to design bridges artistically, seems to me to indicate that bridge engineers often do not sufficiently recognize their limitations. What would be thought of a three or four page article in an engineering journal attempting to cover the ground of bridge design from an engineering point of view? It would probably not be read by bridge engineers whose libraries on bridges scarcely compass the subject. And yet we know of large works on certain phases only of bridge engineering in which a short chapter is worked in upon architecture with no suggestion that the subject is not adequately treated. Just so one may see a page or two in an engineering handbook on first aid to the injured.

It is true that the structural engineer has not always been his own architect, but he has often called in an architect to hang a frosting of style upon a design whose form is already decided upon. I believe that this is a foolish practice and the consequent divided consciousness and lack of unity must result in failure.

Speaking of the architectural designer of buildings and the structural engineer, Claude Bragdon says: "For the most part there is a difference of intention between the engineer and the designer; they look two ways, and the result of their collaboration is a flat and confused image of the thing that should be, not such as is produced by truly binocular vision. This difference of aim is largely the result of a difference of education. Engineering science of the sort which the use of steel has required is a thing unprecedented; the engineer cannot hark back to the past for help, even if he would. The case is different with the architectural designer; he is taught that all the best songs have been sung, all the true words spoken. The Glory that was Greece, and the Grandeur that was Rome, the romantic exuberance of Gothics, and the ordered restraint of Renaissance are so drummed into him during his years of training and exercise so tyrannical a spell over his imagination that he loses the power of clear and logical thought and never becomes truly creative."

This practice of calling in the architect almost as an afterthought, has sometimes also resulted in a more costly bridge than the engineer, if left to his own devices, would have designed, and has at least had a share in fostering the belief sometimes held by the bridge builder that an artistic structure must necessarily cost much more than one which is merely strong and durable. Now nature does not waste material nor does she make things ugly by making them strong and durable, efficient and fitting. Nature here shows what is possible; and indeed beauty of proportion, after it

†Bridge Engineer, Toronto

*"Architecture and Democracy," by Claude Bragdon.

has been attained, as in the Doric column, can often be justified by mathematics.

This is an age of specialization, the result of necessity, and I can see no reason why engineer and architect may not efficiently collaborate in the design of a bridge. But they must understand one another and there must be no confusion of aims. They must be in ideal agreement.

The function of the bridge engineer, as I understand it, is to make his structures safe, efficient, durable and economical. To this end he must solve many problems connected with loadings and traffic, and future traffic, sometimes on two levels, ramps, grades, clearances by land and water, land damages, foundations, ice and freshets. Generally his preliminary studies will show that all his problems may be solved by several different forms of structure in the most available materials. Or to put it in another way, several different engineers would solve a given problem by structures of as many different forms. Moreover, no form will be quite fixed and unchangeable, it will have some elasticity.

It is for the architect, as I see it, to take the not inelastic structure of the engineer, and make it expressive of its purpose; expressive as a whole, within the economical limits of possible range of form, and expressive in its parts. The architect must take the engineer's structure and dramatize it. It is the primary duty of the architect to make the structure truthful. A form which admits of no explanation cannot be beautiful. A three-hundred-foot arch must show its size, even without waiting for the passage of a car to give it scale; a post must look like a member in compression, not like a tie. And if truth is found, Beauty will be there peeping around the corner. Truth and Beauty cannot be separated, they are wedded.

A large part of the architect's education consists in the training of the eye to subtleties and beauties in color, form, and ornament, to which the average engineer is a stranger. This is a qualification not to be despised. Sometimes the application of certain abstract principle of design and proportion on the part of the architect, to an engineer's design may spell the difference between an effect which is more or less unfortunate and one which is fine. Moreover, the architect has a knowledge of the place, function, and character of ornament—when ornament seems to be called for—which the engineer completely lacks. I call to mind many instances of good bridges marred by an attempt at architecture which is a betrayal of ignorance on the part of the designer. These things should never be left for the eleventh hour consideration; if engineer and architect co-operate, as I believe it to be highly desirable that they should, that co-operation should begin at the very beginning, continue to the very end, and be at all times intelligent, friendly close.

When it is suggested that the engineer should have more recourse to the architect, some structural engineers may feel like throwing the "tu quoque" at him and hinting that he often attempts structural problems without adequate knowledge, or perhaps he calls in the engineer merely as a checker which does not give a reasonable chance to attack the problem "de novo," so that the best solution may be found. In so far as there is any truth in this it only leads up by another path to the same conclusion, namely, that there should be an understanding between engineer and architect.

I submit these ideas and suggestions to my profes-

sional brothers with some hesitation. I am a bridge engineer and cannot claim to have thought as deeply upon the functions of the architect as one who has spent years in their practical application. But if a much closer collaboration between the votaries of Art and of Applied Science should prove to be desirable, then I confess that until quite late years I have been one of the greatest sinners. For years I designed bridges and recked little or nothing, of the architect. On some early concrete arches he was shown the nearly finished design and asked to suggest improvements or to point out possible faults. Of late, however, I have come to believe that the architect is one more "problem" that will have to be resolved by the builder of bridges



Mr. Walter Davidson, who was re-elected first vice-president of Toronto Builders' Exchange at last annual meeting

That the Canada Cement Co. has enjoyed prosperity during the period of the war is evidenced by the following comparative figures:

	1918	1914	
Current Assets—	\$5,291,985	\$3,713,404	Increase \$1,572,581
Current liabilities—	634,398	3,220,960	Decrease 2,536,562
Working capital—	4,657,587	492,444	Increase 4,165,143

Out of the 1,100 rural municipalities in the province of Quebec fifty per cent. have taken advantage of the government's subsidies and have made the necessary permanent works along roads to ensure them the grant. This statement was made by Mr. B. Michaud, deputy-minister of provincial public highways, at a meeting in Montreal. The government, he said, favored gravel roads, as that kind was good for a foundation in case any further work was undertaken. The mileage built in a series of years was given as follows: 1912, 115 miles; 1913, 283 miles; 1914, 747; 1915, 436; 1916, 180; 1917, 150; 1918, 210, or a total of 2,000 miles in seven years.

Good Roads Assured for Eastern Ontario

An Enthusiastic Convention of Good Road Enthusiasts—Hon. Dr. Reid Pledges the Dominion Government to Supplement Provincial Expenditures

THE Eastern Ontario Good Roads Association has taken a prominent part in bringing to the attention of the governments the wisdom and necessity of co-operation in the building of National Highways—first as a national utility, and second, as a measure of relieving unemployment during the period of readjustment. The convention of their association, held Tuesday and Wednesday of last week, in Ottawa, brought forth some splendid discus-



Mr. William Findlay, Past President
Eastern Ontario Good Roads Association

sions which added materially to the sum total of information on this important subject, and materially advanced the good roads movement not only in Eastern Ontario, but all over the Dominion. Doubtless the next important announcement was that of Hon. Dr. Reid, to the effect that the Dominion Government was prepared to pay a proportion of the cost of permanent road construction in the various provinces, and that a programme covering five years' operations is well on the way to completion.

The convention programme on Tuesday consisted of an Executive Committee meeting at 2 p.m., a Directors' meeting at 3, and a dinner in the Chateau Laurier at 7. The directors' meeting however was thrown open to the delegates and developed into a general discussion of the Good Roads movement in the Eastern Ontario townships with particular reference to the choice of route between Kingston and Ottawa.

The Evening Banquet

The banquet was attended by some 300 guests, the main dining room of the Chateau Laurier being filled. Among the guests were Hon. Dr. Reid, Minister of Railways and Canals, Ottawa; Hon. Gideon D. Robertson, Minister of Labor, Ottawa, and from the Ontario Government, Hon. Findlay Macdiarmid, Hon. Howard Ferguson, and Hon. Dr. Preston.

Mr. Findlay Honored

Following the toast to the King, Mr. C. J. Foy, K.C., of Perth, rose "to place upon the programme a number that did not appear on it as originally drawn up." He said that the president of the Eastern Ontario Good Roads Association, Mr. William Findlay, had elected to change his residence from Ottawa to Toronto, and in doing so would remove from the district embraced in the Eastern Ontario Good Roads Association. He therefore felt that it was necessary for him to retire from the presidency of that body. Mr. Findlay had taken a prominent part in all the activities of the association. He had officiated at its birth, had been one of the prime movers in its organization, and in everything it had accomplished the influence of his work was apparent.

The association would miss Mr. Findlay and would suffer as a result of his withdrawal from its activities, but they felt they could not permit the occasion to pass without expressing to him in a tangible way their appreciation of his services and the esteem in which he was held by the entire membership.

Mr. Foy then called upon Alderman Denison, who presented to Mr. Findlay, on behalf of the association, a silver electric percolator and rose-wood serving table. The gift, an especially handsome one, bears on a gold plate the inscription: "Presented to William Findlay



Mr. C. J. Foy, Member Executive

by the Eastern Ontario Good Roads Association, February, 1919."

Replying, Mr. Findlay modestly deprecated the suggestion of any such influence as had been credited to him. The success of the Eastern Ontario Good Roads Association had not been due to any effort he had made or to the work of the directors or members. Rather was it because of the deep and widespread interest through Eastern Ontario in the subject of good

roads. This interest was so keen that it only required a vehicle like the association to crystallize it and make it productive of results. The association had been born last year as the result of a sentiment that the roads must be improved, but at that time they realized that while the country was at war no labor or money should be devoted to anything aside from a war purpose.

There could be no better feature or any reconstruction programme than a proposal to engage in the building of a system of permanent roads for Ontario and for Canada. This, he thought, was the first time in the history of good roads that ministers of the Federal Government and of one of the Provincial Governments had sat at the same table to pledge co-operation in a road building programme, and that in itself was a sign that the question had assumed national proportions.

The provision of good roads would give employment to men at a time when such public employment is necessary. "It is a splendid way," said Mr. Findlay, "to take up the slack in the labor market."

In conclusion Mr. Findlay thanked the members of the association for their gift and their good wishes regretted that business demands required his removal from Ottawa, and assured them that the association and its work would always occupy a position very near to his heart.

The "Dominion Government" was proposed by Mr. S. L. Squire, president Canadian Good Roads Association, who coupled with the toast the names of Hon. Dr. Reid and Hon. Gideon Robertson. It was the first time a toast of this nature had been on the toast list of any good roads association. It was an honor, too, because the Government of Canada enjoyed the confidence of

together by one common tie, the desire to improve the roads of the Dominion of Canada, and more particularly the Province of Ontario. He believed the members of the Dominion Government were prepared to co-operate in this work.

Hon. Dr. Reid.

Dr. Reid complimented President Findlay on the work he had done in the interest of good roads and the efforts he had put forth to educate the people to the necessity of improved highways. He regretted that



Mr. W. Y. Denison, Secretary-Treasurer



A. M. Rankin, M.P.P., Member Executive

the people. In these troubled days not many Governments were seated safely in the saddle. Five years ago Canadians were referred to as colonials, but their work in war had raised Canada to a position of one of the younger nations. To-day the Prime Minister of Canada was at the peace conference in consultation with the heads of the nations. The speaker referred to the three methods of transportation, by rail, by water, and by the highway. Of these the most important was the highway, and the guests at the banquet were brought

Mr. Findlay was removing to another centre of activity.

The speaker made the important announcement that "the Dominion Government intends to furnish its share of the money and it is up to the Provincial Governments to see that the roads were built." On behalf of Sir Thomas White, who was unavoidably absent, Dr. Reid stated that the Minister of Finance was willing to do his share in the developing of good roads in Canada.

He also stated definitely that there would not be a department of highways in the Dominion Government, but that the work would be undertaken by the Department of Railways and Canals (Dr. Reid's Department). When it was decided to take up road building as a Dominion measure he had been instructed by the Cabinet to get to work immediately and come to this association with some recommendation as to what he thought should be done. He also told of organizing the highways branch and of appointing Mr. A. W. Campbell as commissioner.

"We are busy," he said. "We are on the job and will remain until we have good roads similar to those in the United States."

"As far as the Dominion Government is concerned the question of good roads has become a live one. We realize that we must have the best methods of transportation and we know and believe it is absolutely necessary to have a complete system of highways."

Dr. Reid commented upon the spirit that prevailed in the provinces towards good roads and thought it was a good omen that the farmers and in fact everyone in the city and country, looked favorably upon programmes for good road building.

In discussing the question of mileage in Canada, the

speaker said he had been informed by the Commissioner of Highways that there were 250,000 miles of road in Canada. Several of the provinces agreed that there should be classification of the roads.

Has Bill Ready.

"I have a bill drawn up for the House," the speaker stated, "and I am going to place in that bill an amount representing our share of what can be expended within the next five years by the several provinces. I want to make the bill read that we can set aside an amount so that road building can commence now and that every province will know that the money is available for completing the roads. The amount of money will be sufficient to cover the Dominion Government's portion. A question to be determined is the proportion of the amount to be spent in Canada that the Government should pay.

"I am going to urge and push through the bill and will ask the Senate to pass it quickly. We feel that it is the work of the Provincial Governments to construct the roads. All we ask or propose to ask is to have the provinces submit plans so that our engineers may be satisfied that the roads to be built will be permanent roads and will be of benefit to the public for all time to come. I think you gentlemen may rest assured the money will be spent to the very best advantage of all.

"The building of highways will give work to many thousands and will, perhaps, save a lot of trouble."

The Minister spoke of the inestimable advantages to the communities of good highways and said that in the Dominion last year there were licensed 262,000 motor vehicles. The whole cost represented about \$200,000,000, and he estimated that the loss in depreciation through bad roads would have built many hundred miles of permanent roads.

In conclusion Dr. Reid said he would do his best to see that all parts of the Dominion have assistance from the Government. "Ontario will have good roads and lots of them within a few years and I wish the association every success."

Hon. Mr. Robinson.

Hon. Mr. Robinson assured his audience that when Dr. Reid's good roads bill got to the Senate it would have at least one hard and fast supporter. Good roads were made necessary by the growth of the automobile traffic which, in Canada, had now reached the point where it represented 5,000,000 horse power, as compared with which the Canadian railways represented but 2,000,000. Good roads would also improve the conditions of the agricultural population and this would be of especial importance in connection with inducing returning soldiers to settle on the land.

It would also help to solve the problem of unemployment as it would provide work for a great many men. He suggested that the work when started should be commenced as near as possible to the industrial centres where there would probably be the greatest amount of unemployment.

Canada's Duty.

Mr. Robertson believed it was Canada's duty to undertake public works as a means of finding work for the idle. In this connection he referred to the establishment of employment bureaus which he believed would be of value in checking the amount of idleness. In England when four per cent. of the population was idle it was deemed time to engage in public works and he believed that Canada should also engage in public

works to furnish employment to the men thrown out of work by the cessation of war. In closing, he stated that the Department of Labor would be pleased at any time to do anything in its power to aid the cause of good roads.

The Ontario Government.

Mr. C. J. Foy proposed the "Ontario Government," and the Hon. Findlay Macdairmid, Ontario Minister of Highways, replied. He remarked that there had been much talk in Toronto recently of communing with unseen spirits. He did not know whether all were on the same plane but he was certain that all present would feel the influence of the unseen spirit of brevity. Two organizations had been formed in Ontario recently in support of good roads. The benefit of good roads was so obvious that it was unnecessary to discuss them, but in view of some criticisms of the Ontario Government's road policy, something should be said of that. The Ontario Government had devoted its energies to the creation of market roads, leading from the farms to the market places and now the province had 10,000 miles of such road. In building good roads the volume of traffic to pass over them should be foreseen and provided for. In this connection he referred to the Toronto-Hamilton road, which it first was proposed to build of light tar macadam. The traffic to pass over that road was foreseen and a cement highway built which would successfully stand up to the traffic it would have to carry. Figures of traffic over the Toronto-Hamilton road taken at different points showed from 1,600 to 2,500 vehicles per day passing over the road, a vindication of the policy adopted in its construction.

The automobile in Ontario was no longer a luxury. In this province there are 100,000 cars and 8,000 trucks. Of the cars 84,000 were under 25 horse power, showing that they were used for lighter business and not for pleasure alone.

The use of motor trucks would increase as they were found the cheapest means of transporting goods on a short haul, therefore roads must be built to stand that traffic.

The Provincial Government has decided that the best solution of the road problem must be by the creation of a provincial system of highways for the traffic over the roads would be too heavy for the ordinary type of road construction.

Mr. Macdairmid also considered the case from the tourist standpoint. In Maine tourist travel was worth \$25,000,000 per year. France, Switzerland and other European countries had found the tourist business profitable and good roads added to the rugged Canadian scenery and wonderful climate would provide a most attractive programme for tourists.

As to the Ottawa-Prescott road he thought the enterprise one in which Ottawa had every reason to be keenly interested for at one end was one of the most beautiful cities on the continent and at the other 30,000,000 people. Much preliminary work had been done by the Ontario Government in regard to the Ottawa-Prescott road. The Government had also taken over the road from Toronto to Whitby, and from Marmilton to Grimsby. Turning to the work done in the way of making grants to counties for road purposes he showed that under the Highway Act, \$3,100,000 had been paid in such grants.

He felt that all present would welcome the announcement of Hon. Dr. Reid and said that nothing

more could be expected from the Dominion Government.

The Farmer's Objection.

The Minister then referred to the resolution passed by the United Farmers of Ontario opposing the construction of motor highways for the millionaires, and another resolution passed by an organization near London, Ontario, asking for delay in road building because of the high cost of materials. He did not believe those resolutions were justified, for it appeared to him that if ever energetic, aggressive action was justified it was now. Canada owed a duty to men who had gone overseas and he believed road construction would, to some extent, solve the problem of unemployment.

Will Go On Building.

The Ontario Government will continue to build the provincial highway system upon the guiding principle that the roads should be equal to all the traffic demands made upon them. The Government's road policy is a well balanced one and one that would meet the demands of the situation. In conclusion he wished the Eastern Ontario Good Roads Association every success and expressed confidence that the Ontario Department of Highways and the Dominion Department would work on the matter of roads in complete harmony.

Mr. Howard Ferguson.

Hon. Howard Ferguson, who also responded to the toast, was impressed with the enthusiasm shown at the banquet. Speaking of the Ottawa-Prescott highway he said few realized the large amount of preparatory work that had been done for the highway. The Government has ten foremen on the road and they are all engaged in preliminary work. But the work should be preceded with slowly in order to insure permanent and satisfactory results. The Ottawa-Prescott road was being widened and part of the highway route was not settled. He asked if it would be wise to lay a surface upon a foundation that had not settled. He would say "go slowly and get the permanent foundation, even if it required another year's work."

"The people of this province are to be congratulated that the work is to be left in the hands of Hon. Dr. Reid," he said: "We are also fortunate in having at the head of the movement such good men as Hon. Mr. MacDairmid and Mr. Campbell. Mr. MacDairmid laid down plans before the Provincial Government and all have been heartily endorsed."

Hon. Dr. Preston, Minister without portfolio in the Ontario Government, paid a tribute to the Eastern Ontario Good Roads Association for the good work it had done, and expressed his satisfaction at the announcement made by Hon. Dr. Reid, and the promises of support given by Hon. Mr. MacDairmid and Hon. Mr. Ferguson. To get the best results from the good road programme there should be unanimous support and co-operation. Local jealousies should be buried in every case. The Ontario Government had foreseen the value of good roads and had placed on the statute books legislation under which it was possible to get such roads. The result had justified that policy.

A. M. Rankin, M.L.A., Frontenac county, proposed a toast to the City of Ottawa, with which the names of Mayor Fisher and Commissioner of Works Macallum were coupled. Mr. Rankin spoke of the wonderful achievements of the E. O. G. R. A., and also stated that

the great need of the province was main highway arteries.

Mayor Fisher.

A hearty welcome to the Capital was extended to the delegates and their friends by Mayor Fisher. He also announced that the city would entertain the "good roads boosters" at a luncheon at the Chateau Laurier at 1 p.m. He was gratified to hear Cabinet Ministers say what they were going to do in road building, for he considered it the greatest investment of all. The Dominion Government had proved this in the Capital. The arrangement with the Government was that it was to build roads in the suburban area and in return Cabinet Ministers and civil servants were to be free from taxation. The Government was to be supplied with free water, fire and police protection. Visitors to the Capital admired the roads built by the Government, but as the city's part of the contract was not visible credit was not given to the city.

"We are prepared to do our share in any road building that is proposed. We have declared ourselves on the Ottawa-Prescott Highway, and with the assistance of the county council we do not see why the toll roads in the vicinity should not be wiped out in the course of a few months."

Commissioner Macallum.

A. F. Macallum, Commissioner of Works of Ottawa, also responded to the toast to the city. He said one advantage of paved roads was that people would prefer to live on them. He congratulated the Dominion Government upon its very correct policy in appointing an engineer as the head of the Good Roads Commission, but did not agree with the statement that roads in the United States were uniformly better than in Ontario. The roads of this province were as good as the average roads in the United States. Mayor Fisher had said that the streets of Ottawa were the best paved of any in Canada. His own opinion was that they were better than most streets in American cities.

A. E. Donovan, M.P.P., of Brockville, then proposed the toast, "The Highway Departments of Ontario and Quebec."

Mr. A. W. Campbell, C. E., responding to the toast, said that a number of years ago he had met in a small Ontario town a young man who was busy organizing an association to promote good roads. The man was William Findlay, who became head of that active organization, the E. O. G. R. A. He paid a tribute to the zeal, in the interests of good roads, exhibited by Dr. Reid. Mr. Campbell also warned against haste in building surfaces upon foundations that had not been properly settled.

Mr. B. Michaud, Deputy Minister of Highways of Quebec, said complaints about bad roads had become very familiar, but very little was heard about good roads. Bodies like the Eastern Ontario Good Roads Association were to be congratulated upon their good work. In any matter of road construction two questions had to be faced—who would build the road and who would maintain it. In Quebec the Government had built some 300 miles of provincial roads. On less important roads the Government had agreed to split the cost with the municipalities. When this work was completed, in five years, the Province of Quebec will have 5,500 miles of improved road or about ten per cent. of the total mileage.

Quebec had spent some \$20,000,000 on roads in the

past, had borrowed the money to pay for them, and would borrow more if necessary.

Good roads had proved of value to Quebec as an attraction for tourists. In 1912 there were but 3,335 automobiles in that province, while last year there were more than 28,000. In 1912 the number of American tourist cars visiting the province was 1,500, while last year 9,061 cars came over carrying some 30,000 visitors. In 1911 the Province of Quebec decided to create a public opinion in regard to good roads. Lecturers were engaged and their lectures advertised. The campaign produced immediate results. What Quebec had done in this regard other provinces could do with advantage. Any road policy to be successful should be broad.

There should be no objection to expenditure for good roads, for their benefit was known, and expenditure when properly managed was to the advantage of the whole country.

Quebec was not behind in road building. One stretch of road between Montreal and Quebec would

form the first part of a transcontinental highway connecting Halifax and Vancouver.

Mr. Routley, of the Ontario Highway Department, also spoke briefly.

The Officers for 1919 - 20

Past-president Wm. Findlay, Toronto, president, Nelson D. Porter, Ottawa; first vice-president, John Brennan, Arnprior; second vice-president, Dr. T. W. Smith, Hawkesbury; third vice-president, W. F. Barker, Portland; secretary-treasurer, W. Y. Denison, 208 Laurier Ave. W., Ottawa.

Executive committee: The past-president, the vice-presidents, the secretary-treasurer; C. J. Foy, Perth; W. J. Fisher, Winchester; Bower Henry, Carleton county; A. M. Rankin, M.P.P., Frontenac county.

Directors: D. E. Johnson, Ottawa; D. A. MacNaughton, Flinch; F. H. Moffatt, Pembroke; W. F. Bell, Britannia Bay; G. F. McKim, Smith's Falls; Mayor Adam Fetterley, Cornwall; Chas. Truscott, Frontenac; and the Executive committee.

President Findlay Reviews the Year's Progress

THE activities of your Executive Committee have been so varied and so numerous that it has been thought best to report to you in detail what we have sought to accomplish and the measure of success which has been attained.

I wish to thank and congratulate the Nominating Committee at the organization meeting in July for the selections they then made of members of the executive committee. Every county in our district has been represented, and every member has been connected with the public life of his county in some special way. A truly representative executive was thus secured, and the wishes and needs of the people in all parts of our district have been constantly maintained before the executive committee, while, at the same time, a spirit of harmony and co-operation has existed throughout. The Association owes a great debt to the members of the executive committee for the outstanding success which has been made of the work which you entrusted to them and for the time which they have given to it.

That their work has been crowned with success is admitted by the most critical. It has commended itself to Cabinet Ministers, Good Roads officials, and good roads enthusiasts in all parts of the province, and in other provinces as well.

It will be remembered that the objects of the Association were stated at the organization meeting to be as follows:

"To foster the study of road building and maintenance; to promote the improvement of the highways of Eastern Ontario; and to secure co-operation in connecting various county good roads systems, thus ensuring a continuous system of improved highways throughout the eastern part of the province."

The organization meeting also directed the executive committee to wait upon the Ontario Government and ask for the designation of the following roads as provincial highways:—

Pointe Fortune to Ottawa;
Morrisburg to Ottawa;
Ottawa to Pembroke.

It was also an instruction that the co-operation of the newspapers of Eastern Ontario should be sought in disseminating Good Roads information.

How far we have been able to proceed with the objects of the Association will be gathered from the proceedings of this Convention. It will be seen that we have devoted ourselves not only to leading roads, but we have made a discussion on county road systems, an important part of our program.

To secure the co-operation of the newspapers of Eastern Ontario, a meeting of publishers was called at Carleton Place on July 27th. It was attended by twenty-three representatives out of a total of forty-one publications; an excellent record. Courtesies in the form of a trip by motor over Lanark county roads were extended by Carleton Place Board of Trade, while the Mayor placed the town council chambers at our disposal for meetings.

The spirit with which the publishers met our proposals was commendable, and was a further evidence of the wide and deep interest everywhere being shown in the affairs of the Association. Always watchful of the public interest, the newspapers of Eastern Ontario have given cheerfully and without stint of their space to the publicity which the Association has sent out. Thanks are also due to Mr. Earl G. Wilson, of Ottawa, for preparing much of this matter.

For the purpose of investigating the provincial highways of the province of Quebec, the executive committee in September visited Three Rivers and vicinity and traversed several highways in the neighborhood of Montreal. They also visited New York State, together with many other members of the Association and municipal officials, with the tours organized by The Journal Newspapers and the Retail Merchants' Association of Eastern Ontario. The co-operation of the latter body in the work of our Association has been helpful, and it is to be hoped that all retail merchants soon will realize the business asset which there is in a good road.

To the list of roads mentioned above, the executive committee added a road from Kingston to Ottawa,

*President Findlay's Address before the Convention of Eastern Ontario Good Roads Association.

traversing the counties of Frontenac, Leeds, Lanark and Carleton.

Following the instruction to seek the designation of the above named roads as provincial highways, numerous petitions were prepared and circulated in the various counties, by the executive committee and others interested. Over seven thousand names were signed to these petitions.

The Honorable the Premier of Ontario, Sir William Hearst, with Messrs. McGarry, Ferguson and Preston, members of his Cabinet from Eastern Ontario, accepted our invitation to attend a Good Roads Congress in Ottawa in September, and at the request of the Central Canada Exhibition officials, the time was fixed during the Exhibition, and Good Roads Day, September 11th, was set apart for this purpose. The Cabinet Ministers were taken over the toll roads about Ottawa, and attended the Exhibition lunch at noon. In the evening they were guests of the executive committee at dinner, and at the Good Roads meeting held in the Exhibition building, the petitions above referred to were presented to the Premier and his colleagues, each of whom spoke in support of the good roads movement and in appreciation of the work of our Association.

It is learned that Good Roads Day now will be an annual feature of the Exhibition, and some co-operation on the part of this Association will be welcomed by the Exhibition officials.

Upon a later occasion, October 2, the executive committee was received by the Premier and his Cabinet in Toronto, when the question of designating these roads as provincial highways was further discussed. It was pointed out then that the provincial highway system had as yet been developed only to include the main road from Windsor to the Quebec boundary, with branch lines to the Niagara frontier from Hamilton, and from Prescott to Ottawa.

It was stated that there would be no difficulty about designating these highways as provincial county roads, and your executive committee then urged the government to so amend the law that such roads could be built on petition of the counties concerned, by the province instead of by the counties.

The following resolution was drawn up later. It represents the view of this Association that the leading roads should be province-owned, province-built, and province-maintained. It has been submitted to and passed by numerous county councils in Eastern Ontario, by several Boards of Trade, and by the council of the city of Ottawa.

"Whereas under the provisions of the Highways Improvement Act, the construction and maintenance of provincial county roads is undertaken by the various counties concerned, the Government of Ontario contributing sixty per cent. of the cost and maintenance.

"And whereas, it is the opinion of that it would be in the public interest that such roads should be constructed by the province in cases where in the opinion of the county or counties concerned, the full benefit of the engineering skill and executive resources of the Provincial Department of Highways is necessary.

"Therefore, be it resolved that hereby humbly petitions the Government of Ontario to amend the said Highways Improvement Act so as to provide that the government may, when so requested by the county or counties concerned, assume the ownership, construction and maintenance of any provincial county road in the same manner as a provincial highway under the Provincial Highways Act, 1917, except the proportion of the cost and maintenance to be paid by the government shall be sixty per cent. as at present provided by the Highways Improvement Act."

The status of the various provincial highways and

provincial county roads in the eastern part of Ontario is understood to be about as follows at the present time:—

Provincial Highways

Kingston to the Quebec Boundary, designated by the province, about 137 miles.

Prescott to Ottawa, designated by the province, about 58 miles.

The right of way for this road has practically all been secured with the exception of the last three miles leading into Ottawa, the route of which is not yet settled. To this point, the engineering is understood to be completed. Tenders for the construction are now being prepared, and it is expected that definite information on this subject will be imparted by Mr. H. T. Routly, the newly appointed Superintendent of Construction of the Ontario Highways Department, who is making his first public appearance at this convention.

Provincial County Roads

Morrisburg to Ottawa, about 47 miles; designated by the province to the border of Carleton county; about three miles of temporary improvement has been made on this road in the county of Dundas. This is the road known as the Whitney Memorial Road.

Pointe Fortune to Ottawa, about 72 miles; designated by the province to the border of Carleton county; the portion in this county likely will be included in the proposed suburban road area about Ottawa.

The united counties of Prescott and Russell have arranged to raise \$200,000 for road building purposes this year, and have added to their road building plant four new outfits. It is, therefore, expected that a considerable amount of work on this road will be done by these counties during the coming season.

Kingston to Ottawa, about 115 miles; designated by the counties of Frontenac, Leeds and Lanark to the border of Carleton county.

Ottawa to Pembroke and Petawawa military camp, about 97 miles; designated by the county of Renfrew to the border of Carleton county.

This is a total of approximately 195 miles of provincial highway and 331 miles of provincial county roads in Eastern Ontario, or 526 miles in all. This system, planned after the most careful investigation, will, it is confidently predicted, remain the backbone of the common highways system of Eastern Ontario. Its early completion depends upon the energy with which the people of these counties pursue the attainment of good roads, and the co-operation which the government is in a position to extend. There is a confidence, also, that all—or a great deal—of this mileage will be included in the scheme of national highways should the Dominion Government enter upon its suggested plan of roadbuilding in co-operation with the provinces.

In Carleton County the good roads situation is a difficult one, and some of those who have criticized this county have been unaware of the obstacles to road building in it. Because of the location of Ottawa and the consequent density of traffic near this city, and the existence of so many toll roads, road building in this county promises to be extraordinarily expensive. Efforts have been made from time to time to interest the county in a co-operative scheme with the city of Ottawa, but nothing has been accomplished till recently, because no comprehensive scheme has been submitted.

It will be seen that the provincial highway from Prescott, together with the provincial county roads from Pointe Fortune, Morrisburg, Kingston and Pembroke, traverse nearly every section of this county.

Coupled with the proposal to secure the co-opera-

tion of the city of Ottawa in a suburban road area, and perhaps as well, that of the Dominion Government in a metropolitan road area, the problem simplifies itself from a financial standpoint and becomes attractive to every township in the county.

Your executive committee, with the able and experienced help of Mr. A. M. Rankin, M.P.P., one of its members, laid before the council of Carleton county in December a proposal to appoint two representatives as a committee to treat with representatives from the city of Ottawa, the Dominion Government, the province of Ontario and of this Association, in relation to the establishment of a metropolitan road area, comprising about 120 miles adjacent to Ottawa, and failing that, a suburban road area, comprising about 50 or 60 miles.

The county appointed Warden Bower Henry and Mr. Alex. Dow. The city appointed Messrs. W. Y. Soper and W. Y. Denison, together with the Mayor, Commissioner of Works Macallum and Controller Kent. Your Association appointed Messrs. Rankin, Foy, Robert Preston, R. H. Grant and R. H. Cox.

The following resolution was passed by Ottawa city council and a similar one was passed by the council of Carleton county:—

"Whereas, the matter of building permanent highways in the district surrounding this city is now a live issue owing to the great need thereof, the possibility of undertaking public works owing to the discontinuance of the war, and the consequent intention of the governments of both the province of Ontario and the Dominion of Canada to embark on a road-building programme, partly as a measure of re-construction; and whereas, under the laws of the province of Ontario, a so-called 'suburban road area' surrounding this city may be laid out to which contributions for construction and maintenance will be made in the following proportions: City of Ottawa, 30%; county of Carleton, 30%; province of Ontario, 40%; and whereas, it is believed that the other bodies concerned will be agreeable to meeting a committee representing this corporation to discuss the enlargement of said proposed suburban area into a metropolitan road area, to which a contribution would be made by the Dominion of Canada as well as by the province of Ontario, the county of Carleton, and the city of Ottawa, therefore, be it resolved that Messrs. W. Y. Soper, W. Y. Denison, the Mayor, Controller Kent, and the Commissioner of Works be appointed a committee representing this city to discuss with a similar committee from the county of Carleton and representatives of the Dominion and Ontario governments and of the Eastern Ontario Good Roads Association the feasibility of uniting in the creation of a metropolitan road area surrounding Ottawa; and if such should be found impracticable, the creation of a suburban road area under the Highways Laws of Ontario, said committee to report to this council as early in the year 1919 as may be possible."

The conference of the above representatives took place at the City Hall, Ottawa, on Tuesday, January 7th. It was attended by Mr. W. A. McLean, Deputy Minister of Highways of Ontario, who explained the law in regard to the erection of a suburban road area. He indicated that the mileage in the suburban area would be approximately one mile to each two million dollars of assessment of the city, which would make a mileage for Ottawa in the neighborhood of fifty or sixty miles. The annual cost to the city is not to exceed one-half a mill on the dollar, which would set a limit of about \$60,000 a year on the city's share. Mr. McLean also explained that the Prescott Highway would not be included in the suburban area, as it is the intention of the government to maintain this as a provincial highway from the border of Ottawa city to the town of Prescott.

The following were the representatives of this conference:—

Appointed by Carleton county: Bower Henry and

Alex. Dow. Appointed by the city of Ottawa: W. Y. Soper and Alderman W. Y. Denison, Mayor Fisher, Controller Kent and Commissioner of Works Macallum. Appointed by the Western Ontario Good Roads Association: A. M. Rankin, M.P.P., and C. J. Foy. It had been intended to restrict the representation to two members from each body, but Ottawa having appointed five members, your Association added three more from Carleton county to balance the representation with the city, and Messrs. R. H. Grant, Robert Cox and Robert Preston accordingly were appointed. In the absence of Mr. Rankin, his place was taken at the conference by your president.

The following resolution was unanimously passed:

"This meeting of representatives of the county council of Carleton, the city council of Ottawa, and the Eastern Ontario Good Roads Association, having heard the discussion on the suburban road area and certain provincial county roads, including an address by Mr. W. A. McLean, Deputy Minister of Public Highways for Ontario, resolves as follows:—

1. "To recommend to the county of Carleton the designation and construction as provincial county roads of the following roads in Carleton county: The Pointe Fortune Road, the Morrisburg Road, the Kingston road to Ashton Station on the border of Lanark county; the Pembroke Road to a point on the border of Renfrew county near Arnprior.

2. "To recommend to the county of Carleton and the city of Ottawa the erection of a suburban road area adjacent to Ottawa; the erection of said suburban area to include the purchase of the toll roads in Carleton county."

On the motion of Mayor Fisher, of Ottawa, Messrs. Henry and Soper were appointed to meet with the owners of the toll roads to find out the terms upon which they are willing to sell. As representing Ottawa, the Mayor definitely stated the city is prepared to go into the suburban road area scheme.

Inasmuch as the policy of the Dominion Government in reference to road building had not been declared, it was necessary to abandon in the meantime the question of erecting a metropolitan road area. Carleton county has since declared in favor of a suburban area, and appointed Messrs. Ben Rothwell and F. A. Heney, two of her most substantial citizens, as commissioners. The city of Ottawa, it will be noted, has also declared in favor of a suburban road area, and thus the solution of this long-standing problem of good roads adjacent to the capital city, and the consequent abolition of the toll roads, is a prospect for the immediate future.

While it might be gathered from the above that the work of this Association has been concentrated upon the leading highways, such is not the case. It is hoped that a discussion on county road systems will occupy a prominent place on the program of this convention. One of the objects of this Association is for the executive committee to secure and present extended reports on the work in all the eastern counties of the province. We realize that expensive roads cannot be built on every concession and line, but we are equally of the opinion that every section of our district is entitled to access to these leading roads.

As a director of the Canadian Good Roads Association, your President was privileged to move the adoption of a resolution of that body as follows:—

"The directors of the Canadian Good Roads Association have observed with satisfaction the announcement that the building of modern permanent highways will form an important part of the reconstruction program of the Dominion Government, believing as they do that no other public works are more urgently required, in connection with improved conditions in agriculture, industry, and of the people gener-

ally, or will afford so much labor in proportion to the money cost.

"This association is aware that various provinces already have well organized highways departments, equipped in a personal way with engineering and executive skill, and possessing a vast amount of information about road conditions and requirements in their respective provinces, together with knowledge of the sources of road building materials, etc.

"Appreciating the efforts of the Dominion Government in reconstruction work and the call which has gone from Ottawa for assistance in such work on the part of all bodies, governmental or other, to assist in the manner in which each is best fitted to do, and realizing the advantage of avoiding the duplication of effort;

"This Board unanimously resolves as follows:—

"1. To communicate with the governments of the various provinces respectfully suggesting that they offer to carry out such highway building plans as may be arranged, on a basis as to cost between the Dominion and the provinces to be agreed upon.

"2. To communicate with the Government of Canada pointing out the facts recited above, and respectfully suggesting that the Government of Canada favorably consider the advisability of using the road-building knowledge and facilities of the provinces, in consideration of certain expenditures by the provinces themselves, and that the Government of Canada call into council at the earliest possible date representatives of the various provinces, to give effect to so much of this resolution as may be agreeable."

An appointment was arranged by your executive on behalf of the various bodies interested, which waited upon the Government of Canada to urge the form of co-operation outlined in the resolution of the directors of the Canadian Good Roads Association.

On December 9th the delegation was received by the Hon. Sir Thomas White, acting Prime Minister, the Hon. J. D. Reid, Minister of Railways, the Hon. N. W. Rowell, President of the Privy Council, the Hon. G. D. Robertson, Minister of Labor, the Hon. Frank Carvell, Minister of Public Works, and the Hon. J. A. Calder, Minister of Immigration.

Your executive committee attended in a body, and the other organizations represented among the delegates were as follows:—The Canadian Good Roads Association, the Ontario Good Roads Association, the

Quebec Automobile Club, the Toronto Board of Trade, the Ottawa Motor Club, the Ontario Motor League, the Hamilton Board of Trade, the Canadian Automobile Association, the Automobile Club of Canada, the Ottawa Board of Trade, the Manitoba Good Roads Association, the Nova Scotia Highways Association, the New Brunswick Highways Association, the New Brunswick Automobile Association.

Assurances of careful consideration by the Dominion Government were conveyed to the delegation by the Honorable the Acting Prime Minister.

Your Association is indebted to the various municipalities which have contributed to its funds. Only by continued financial support from such sources can the good work go on. No donations have been sought or accepted from any supply or machinery firm, or from anyone interested in a financial way in the business of road building. Your association has not sought a grant from any government.

The report of the secretary-treasurer will give complete details of the financial affairs of the association. It will be noted that more money is required than was secured last year.

In order to give your association the status of a body politic and corporate, application for its incorporation has been made by C. J. Foy, K.C., the association's solicitor, and a charter has been granted, at a cost of \$10 to the organization.

In laying down the office of president of your Association, I cannot omit extending my sincere thanks to all of those who co-operated in its organization and its subsequent success. Those who follow this year's executive committee will find a great deal of the pioneer work done, but new problems will constantly arise which will demand the best and most representative men you can select, if this Association is to continue to represent the Good Roads sentiment of this sort in Ontario, and if Eastern Ontario is to remain, as she is to-day, the leader in this respect in the whole province.

Good Roads in Lanark County

By Mr. C. J. Foy*

THE history of Good Roads in the County of Lanark is the history of modern progress in the said county. In this movement Lanark County is one of the pioneers in the business of Ontario.

The county is for the most part composed of heavy soil and as a matter of fact the roads during certain seasons of the year were very bad indeed, in fact in some instances well nigh impassible, so that the matter of the road making became of vital interest to the people of the county from a view point of necessity.

The question was first taken up at the Farmer's Institute meetings, but received very little recognition, as apparently the full import of the benefit of good roads had not yet dawned upon the farmer and urban resident in its full significance. Some twenty years or more, the Ontario Government began an agitation for good roads throughout the province, Mr. A. W. Campbell being placed at the head of the department, having this work in charge. Mr. Campbell was invited to visit Lanark County and gave several interesting and in-

structive addresses in connection with good roads, their value and importance both to the man on the farm as well as those in the towns and villages. The matter was not lost sight of, because Mr. Campbell visited various sections of the county many times, and also took the matter up with the County Councils, until finally the provisions of the Highway Act, as it then existed, was taken advantage of by the County of Lanark, and accordingly on the twenty-eighth day of June, A. D. 1902, a by-law was passed, purchasing the existing toll roads and designating certain roads in the County of Lanark, of which the toll roads so purchased formed a part, and it embraced every township in the county in the improvement of public highways and thus forming a County Highway System. In this by-law the sum of \$65,000 was asked for the purpose of defraying the cost of building the said designated roads. In that same year work was begun on the good road system in the County of Lanark, and from that time to the present it has never been allowed to lag, but each and every year since that date, the roads have been built, improved and maintained in accordance with the stand-

* Reeve of Lanark County, before Convention of Eastern Ontario Good Roads Association.

ards required by the Ontario Highway Act and under the superintendency of the department at Toronto.

As before stated, this movement on account of the quality of the soil in Lanark County in general was forced upon us, as the roads were in a very bad condition at certain seasons of the year, and the whole county, through the County Council, finally resolved to pull Lanark out of the mud, and as a consequence the by-law, as before mentioned, was passed some seventeen years ago. Since that time, as far as it is



McIlquham Bridge, Lanark County—"As it was"

possible, every detail of the Act has been put into operation in the county. We have a splendid organization, including construction gangs, repair gangs and maintenance gangs, the latter properly called patrol system, and the work is carried on under the supervision of the Superintendent of the County Highway System in conjunction with the Roads and Bridges Committee of the County of Lanark.

Of course in the construction and repair we have made our mistakes, which is only one evidence of our humanity, but at the same time we have profitted by our mistakes and as far as possible no mistake has been repeated.

In the construction of roads seventeen years is a fairly considerable period of time and from that day to this many radical changes have taken place, not only in the construction of roads, but also in their use. When we built our roads, we built for the requirements of the times, but times have changed and so has the means of locomotion. I am quite safe in saying that had not the automobile, which in some quarters has been called the most up-to-date method of destruction on good roads yet invented by man, if this had not made its appearance, the roads we built and the manner we built them would have withstood the traffic for which they were designed admirably, but since the advent of the automobile, we have found that the change brought by it as a means of conveyance, institutes a change in the building of roads to meet its requirements.

I am stating only a fact when I say that the unbound macadam road, with the increasing automobile traffic thereon, is simply a waste of money at the present time, because the automobile is here to stay, and is here to stay in ever increasing numbers, not only for

pleasure, but also as a means of transportation for farm commodities as well as the products of the cities, towns and villages.

The auto truck will soon be in general use and highways must be built to receive this traffic. We have realized this in the County of Lanark to the full and we further realized that in order to meet changed conditions, we must also make a change in the mode of construction of our roads, both as to quality and material. Bearing this in mind, our policy in road building has changed as circumstances changed and we are today constructing our roads so as to present an unbroken surface to all traffic and thus protect the metal and other substances which we place upon our roads from being wasted by the traffic that now takes place upon them.

In the construction of our roads we have spent from 1902 to December 31st, 1918, the sum of \$380,400.59.

Another problem that we were met with and which is not met with in very many counties in the Province of Ontario, was the construction of our bridges. We realized that no road is any stronger than its weakest bridge and we early saw that our bridges would have to be constructed of such material and of such workmanship as would meet the demands of the traffic that would be upon our roads. We have in our county a river that has been a costly luxury to us as far as bridge building is concerned, because it has necessitated the building of five or six bridges, all of them being over three hundred feet in length, and in fact one with its approaches being five hundred and eighteen feet in length. I refer to the Mississippi River, which runs through our county. But we undertook the work and for the last five or six years have built a bridge each year and the contract is now let for another



McIlquham Bridge, Lanark County—"As it is"

bridge over three hundred feet in length, which will be constructed in 1919.

Our bridges are constructed of concrete with steel superstructure reinforced with concrete roadbed and according to the Department at Toronto, we have the finest constructed bridges in the County of Lanark for their size there is to be found in the Province of Ontario. We have expended on bridges alone the sum of \$79,702.11, and when the bridge to be built in 1919 is

completed, it will only leave one more bridge in the County of Lanark of three hundred feet in length to be constructed. It must not be forgotten that while we were constructing the larger bridges, we also constructed several small ones and furthermore constructed concrete culverts where necessary.

In the construction of bridges we have performed the work ourselves, and in the time we have been at the work we have evolved the finest system of bridge building and bridge builders that can be found any place, as an example of what we have done I may state that in 1918 we constructed a bridge with its approaches five hundred and eighteen feet long, nine concrete piers and abutments and concrete road bed in the short period of two months from the time we broke ground. We always make provision for our material, such as gravel, cement and sand the winter previous to building our bridge. The contract for the work required is always given to the lowest tender and when the work is undertaken we never have a hitch, because we have planned our work in such a manner and now have the same in such shape that we justly pride ourselves upon the system we have evolved.

During the year 1918 we expended on good roads construction the sum of \$65,278.18, and in the year 1919, we contemplate an expenditure much in excess of \$100,000, because at our last session of county council, which ended on Saturday, the 1st day of February, we passed a by-law authorizing the issue of debentures for the sum of \$100,000, for good roads construction. These debentures bear interest at the rate of five and one-half per cent., payable in twenty years, and within two hours of the time the by-law was passed, our debentures were sold at a splendid figure.

Now, it must be expected that in such a length of time we have been able, to notice many things that could work for the betterment of the road system, and one thing we have found out is that the best is none too good and it is false economy building a road, or attempting to build it, unless it is done thoroughly. First, last and always, the paramount essential is drainage, because without proper drainage, no matter what substance is placed upon the road, failure will surely be the result, but with proper drainage the battle is half won. Then after the drainage is properly attended to, the material and manner of placing it upon the road is the next condition.

I think I am stating a fact when I say that no road can be built too well, because the better you build a road at the outset and the better drainage you have, just so long will you have deferred the maintenance problem, which is to-day the big problem in road building.

My advice to all municipalities undertaking road building is to build the maintenance into the road and in every way make the road so good at the outset that the maintenance will be deferred.

There is no place that more vividly illustrates the old saying, "that a stitch in time saves nine," than in maintaining a road, and the time to fix the road is then, that is, when the first evidence of want of repair is shown. That is where the patrol system comes in, and it should be so systematized that the work will be carried on on exactly the same principle as is in vogue on the railway companies, who employ their section-men and section gangs to do repair work.

Another matter that could readily engage the attention of the Government is that of wide tires on all vehicles whether horse drawn or otherwise. True it

is that there is a provision in the Municipal Act now, for the purpose of legislating as to wide tires, but it is left optional with the county council, as the word "may" is used, and to my mind, that word should be changed to "shall," and the Government should fix a time when vehicles carrying weighty load, should have a sufficient width of tire to protect, as far as possible, the road where the load is weighty and the tire narrow, which has the effect of forming ruts, and ruts are the worst feature in connection with the maintenance of a road. There should be a well organized effort made with automobile clubs, good roads associations, farmers clubs and others, to educate the users of the roads to keep out of the ruts, and by so doing one of the big problems of road making and road maintaining would be solved.

Another matter that should engage the attention of legislature, to my mind, is the injustice, or apparent injustice, that now exists in connection with the farms lying contiguous to the good road in contrast with farms not so situate. There is no question whatever that the farms in front of which the good road is constructed, which means a good road winter and summer, has its selling value enhanced very materially, but, to my mind, there should be some local improvement feature introduced into the good roads act covering the above or amending the assessment act, which would give the assessor power or authority to assess the farms so situate higher than those not enjoying such a convenience.

True it is that power may be in the assessment act at present, but it is very doubtful under the wording of certain sections whether on an appeal to the Court of Revision any such assessment could be sustained, but in any event, it is my belief, that there should be some means whereby farmers having a direct advantage out of good roads running in front of their farms should have to pay more than farmers not so advantageously situated.

There is another feature of good roads construction which should be brought to the attention of the Government, and that is the percentage paid for construction and maintenance of county highways. To my mind, there should be at least fifty per cent. paid by the Government for construction and a like sum for maintenance, because of the County Provincial Highway is to receive sixty per cent for each of the above purposes, it is quite obvious there can only be on County Highway in each county, so if the traffic on purely county roads must of necessity be as great in a measure as that on County Provincial roads, because the county road must be a feeder, therefore, to my mind, it is just as essential that the county roads should be built to a better standard than they are now, and if built to a better standard it will certainly require more money to do so, therefore I submit that the grant from the Government should be at least fifty per cent. both for construction and maintenance.

In our county we have the municipalities taking advantage of the provisions of the Ontario Highway Act, whereby the municipality through which the road runs, pays sixty per cent. of the cost of construction and the balance being borne by the Government, as in the county system, and we find that there is a growing desire to extend this principle each and every year.

Now as to maintaining of the road in winter, this is just as essential as in other seasons and this is where our patrol system worked most efficiently in seasons when their services were called upon, such as the win-

plough that makes the road suitable for traffic, and we have them located in various portions of the county, with instructions to the patrol men to use them when, and as often as required, with the result that even with such a winter as we were confronted with last year, our county roads were kept in such a state as practically speaking left no inconvenience to the general public using them. No doubt it means considerable money to do this, but it was money well spent, by reason of the fact that the farmer was able to continue hauling all his farm produce as well as wood, which meant a great deal, not only to the farmer himself, but also to the urban resident from a point of convenience.

In conclusion I compliment the Eastern Ontario Good Roads Association for the work which it has accomplished in the short space of its existence. Its aims and objects met with the heartiest approval and endorsement of every part of the province interested in this good road movement, and by working in unison with ourselves and with the Government, much good can be accomplished and I feel there is a good future yet before the Eastern Ontario Good Roads Association in building up a bigger, better and larger Ontario.

The Year in Frontenac County

By Mr. A. M. Rankin, M. P. P.

IT was the intention of the Executive that each member describe the work in their respective counties. I may say that the good roads of Frontenac County comprise approximately 160 miles, divided as follows: 100 miles country roads, 50 miles suburban roads, and 10 miles provincial roads. Of the county roads we have constructed a considerable mileage as well as built numerous bridges and cut down several hills. The approximate cost of our county roads run from \$1,500 to \$2,000 per mile. Our bridges are all of permanent structure, of reinforced concrete, and have a twenty foot clear driveway. Since our suburban work has only been established for two years we have only undertaken hill cutting, bridge construction, culverts and drains. We have tried to keep our roads smoothed up until after the war, and by so doing we have considerable mileage ready for permanent construction. It is the present intention of the Suburban Commission to make a survey of our roads within the suburban area and estimate the cost of a bituminous macadam road, so that we may be able to tell our people what it is going to cost them per thousand of assessment for this type of construction. We believe that when we have estimated the cost we will receive their endorsement to go ahead and build permanent roads, within the area, as our people in the part from the county system have more of a patch work system than a continuous permanent construction, which does not meet the day's requirement of traffic. In order to carry out this permanent construction, it will be necessary to issue debentures. The present generation has done its duty by posterity. It has borne out only its burden of death and suffering due to the war, but has assumed more than its share of financial obligations.

But, there is one other thing to which we will have to give serious consideration. That is, to discriminate between the people who are living on such a highway and the people who live back a concession or two, by a system of frontage tax. It doesn't look anything but

fair and reasonable that a man who has a permanent highway pass his door should pay a little in addition to the other man, as such a highway is bound to enhance the value of his property. If you take a hundred acre farm, working it out at one and a half cents per foot frontage, the tax would only mean \$9.90, and I think when laid before any reasonable man, if he had his choice between an improved and unimproved road, he would rather pay the tax and have the improved road. This is a matter upon which I would very much like to have an expression of opinion by the Convention.

Under the present heavy motor conditions in our country, it is necessary that we embark on a system of permanent construction. By doing this, we would eliminate a heavy maintenance charge and give the people something for their money in a reasonable space of time. It is just as necessary to maintain the same standard of work on the concession and county road, in proportion to the traffic, as on the provincial road, in order that the former may be able to market his produce at the lowest possible cost.

Did you ever consider how necessary transportation is to business? You cannot have good business without good transportation. You can't have good transportation without good roads. Look at the lesson the war has given us. The only thing that saved Verdun was France's splendid highways. The Allies would not have been able to mobilize their resources for war on such a grand scale if it had not been for their motor transport fleets and the good roads were ready for the emergency. Are not the highways as vitally important for the conduct of peace as for the conduct of war? With half the world going to bed hungry every night and the millions doomed to starvation, is not the swift construction of highways to the acre that produces as urgent a necessity as were the roads in the battle zone? And, if the need is so urgent, should the nation slacken its efforts or permit its road-building equipment to be sold or dissipated? Should it not proceed with the construction of highways at home, on a scale in accordance with the importance and urgency of the need?

Organization of Italian Machinery Importers

There has been constituted at Milan, among the most important firms in Italy carrying on an import trade in industrial machinery and machine tools from the allied countries, the Italian Association of Importers and Merchants. The purpose of this organization, as outlined in the statute creating it, is the study, protection, and promotion of all those interests appertaining to the importation of the articles mentioned.

The Toronto Chapter of the Ontario Association of Architects held a luncheon last Wednesday, at which there was a very full representation of the architectural fraternity in the city, Mr. C. B. Sissons, secretary of the Ontario Housing Committee, being present as guest of honor. There was a general discussion on the housing situation, and Mr. Sissons invited the chapter to appoint a committee to advise in regard to the planning and erection of small houses, stores and apartments. Resolutions of sympathy were adopted with the families of the late Edmund Burke and the late Isidor Feldman, both of whom were members of the chapter.

All Steel Factory and Shop Equipment for John Bertram & Sons

High-grade furniture steel has proven most adaptable and versatile in the construction of factory and shop equipment, such as cabinets, shelving, stock-room partitions, lockers for employees and for material, etc., and is fast being adopted by Canadian firms generally. There are many reasons for the universal use of steel in such items of equipment, chief among which are its quality of being fireproof, its capacity to bear heavy weights, its indestructibility, its capacity for standardization, permitting a concern to start with a small amount of steel equipment and add other uniform pieces as requirements demand, and its low ultimate cost as compared with wood. The Denis Wire & Iron Works Co., Limited, of London, Ont., have pioneered in this industry in Canada, and have achieved for their well-known line of "Dennisteel" factory and shop equipment a high reputation for quality and durability. Recent figures on work just completed for The John Bertram & Sons Company, Dundas, Ont., are of timely interest. In the warehouse for small tools alone, this company had no less than one-tenth of a mile of Dennisteel shelving installed, with bin fronts, label holders, etc., besides a great many stacks fitted with drawers for small drills, taps, etc.—aggregating a total of some 1,200 drawers, each with label holder to indicate contents. These stacks are built to carry extremely heavy weight on account of the nature of the material stored. The standard Dennisteel type shelving and drawers was used in anticipation of the necessity of adding similar units from time to time. All this equipment was planned and installed so that the stacks, instead of being placed along walls, run out from the walls to the centre of the warehouse, leaving passageways between, and the layout is such that between each row of stacks there is a window, providing sufficient light and air. All stacks extend the same length, and the whole presents a most orderly, uniform appearance, and will make the task of stock-taking comparatively simple. For the same firm the Dennis people are installing some 200 steel wardrobe lockers for the use of employees, besides complete equipment of steel tables, footrests, stools, etc., in the drafting room, the whole making one of the most up-to-date installations of all-steel units in the Dominion of Canada to-day.

C. A. Dunham Co., Ltd.

The C. A. Dunham Co. Ltd., Toronto, announce that a change has been made in their branch sales office at Montreal. Mr. A. Kastello, recently superintendent of construction for the Imperial Munitions Board, at Trenton, but formerly with the Dominion Government and Grand Trunk Railway, has been installed as branch manager in charge of their office at 711 New Birks Building. Mr. Kastello is to be assisted in the company's growing business by Mr. F. O. Hamel, as heating engineer. Mr. Hamel was formerly first assistant engineer in the Public Works Department at Ottawa. The C. A. Dunham Co. Ltd., are very optimistic over the prospects of building activity, and this change has been made to strengthen their organization and to render better service to their trade and clients in Montreal. The company has experienced a very healthy growth during the war period through wider use of its product under conditions requiring more efficient heating methods.

H. T. Routly Chosen as Construction Engineer on Provincial Highways

Mr. H. T. Routly, of the Routly Road Company, Ltd., Toronto, has been appointed construction engineer of the Ontario provincial highways. Mr. Routly will have entire charge of the engineering staff on the contract work, and of the foreman and employees on grading and bridge building operations and on maintenance of the designated roads not actually under construction, also of all plants owned or to be purchased by the Government. He is a thoroughly practical man, and besides having a wide knowledge of road building as a contractor, is a qualified engineer, being an honors graduate of the School of Practical Science, Toronto. Mr. Routly has carried out



Mr. H. T. Routly

large contracts in Ontario, Quebec, and in the States, and has done a considerable amount of surveying in the Porcupine district. His appointment was entirely unsolicited and is a compliment to the contracting side of the profession of engineers.

The new construction engineer was born in Victoria County, Ont., and is a young and energetic Canadian who may be depended upon to do good work for the Government, and to see that the province and the contractors are fairly dealt with. It is understood that Mr. Routly will recommend that highway work be done wherever possible by contract rather than by day labor, and as a contractor, it is certain that those entrusted with contracts by the Government will find a sympathizer in Mr. Routly who has been through the mill and knows the difficulties under which work is often carried out.

It is a condition of the appointment that Mr. Routly devote his entire attention to the work, and he is therefore disposing of his entire plant and interests. Mr. A. E. Jupp, who has for the last ten years been superintendent and manager of Mr. Routly's contracting interests in Toronto and York County, has purchased the stock of the Routly Road Company Ltd., under which name the Toronto and York County work has been carried on. Mr. Jupp, who has largely contributed to the development of the business, will continue to conduct operations from 47 Sparkhall Avenue, it being expressly stipulated however, that the name "Routly" be eliminated from all further business.



Revised map of the proposed Highway improvements in Eastern Ontario — Where these roads will lead to and what they will do.

Courtesy Ottawa Journal-Press

This map is a revision brought up to date by the Ottawa Journal of the good roads programme in Eastern Ontario. It is possible now to classify the proposed roads more clearly, although any classification is liable to be upset. The enthusiasm and activity of the people along any proposed highway is liable to lift that highway into the next higher class.

Roads shown as "County" or "Proposed County" are liable to be Provincial County Roads when built. Of course, it is not pretended that every county road in Eastern Ontario is shown on the map. It is possible to indicate only the more important ones.

The Provincial Highways shown—from Kingston to the Quebec boundary and from Prescott to Ottawa—are sure to be National Highways if any scheme of Federal aid becomes effective. It is altogether probable that the Provincial County roads shown will become national highways, namely, the roads from Kingston and Morrisburg to Ottawa, and the Ottawa river road from Pointe Fortune to Pembroke.

Eastern Ontario is in a very favorable position to receive any extensive scheme of highway improvement because of the designation of these provincial and provincial county roads, largely through the effective organization and support of the Eastern Ontario Good Roads Association.

The provincial county road from Brockville to Arnprior, passing through Smith's Falls and Carleton Place, and with a line from Frankton over to Richmond, connecting up with the Ottawa suburban area, is one to be started, it is hoped,

within a short time. The stone road from Smith's Falls to Brockville is much travelled now. There is a demand for the road shown from Kingston to Renfrew. It would open up the north end of Frontenac County and a number of the back townships of Renfrew. The scenic attractions are very great, and in addition there is a necessity for this road as an agricultural thoroughfare.

The suburban road area about Ottawa is shown as including the Montreal road to the county boundary, where it will connect with the Pointe Fortune road; the Russell road towards Navan to the county boundary; the Bank street road to the end of the toll road; the Hunt Club road to Manotick, thus forming a belt with the Provincial highway on the other side of the Rideau river; the Merivale road with a connection to the Provincial Highway, and the Richmond road to Richmond. The Prescott road will not be a part of the Suburban road area, but will be under the jurisdiction of the Province from end to end. Good roads between the lower Ottawa and the St. Lawrence river also are required and are shown on the map. Some of these already are laid out, and portions are actually constructed as county roads.

The Montreal-Hull road is shown in Quebec Province. It is completed for a distance of seventy-five miles from Montreal now, and its completion is said to be on the programme of the Quebec Government for the coming summer. This road also will extend to Sheenboro, above Pembroke, according to promises made by the Quebec Highway Minis-

ter who went over the route last summer. The Gouin Highway up the Gatineau also is shown. The route is slightly changed. As a result of efforts of the people of Breckenridge and other points close to the Ottawa river, it will swing down to the river above Breckenridge and follow the Aylmer road into Hull. This diversion will add to its usefulness without detracting from its scenic beauty.

It will be noticed that a "cut over" is provided from the Hull-Sheenboro road at Shawville to Portage du Fort, where a bridge over the Ottawa river is located. This road is being improved now, and the people of the locality are very anxious that it should be continued on the Ontario side to link up with the proposed Pembroke road. This would furnish a fine belt for touring purposes on both sides of the Ottawa river and would also form a connection for business purposes between the two Provinces. For this map and the descriptive matter we are indebted to the Ottawa Journal-Press.

Mainly Constructional

East and West—From Coast to Coast

The advisability of motorizing the garbage department and conserving wet garbage is being considered in Hamilton, Ont.

The citizens of High Bluff, Man., have decided to erect a community building as a memorial to the men who have fallen in the war.

The St. John city council has decided to place pavement on portions of Prince William, Germain and Union Streets, the coming summer.

In January there were building permits issued in Welland, Ont., to the value of \$15,255, as compared with \$20,410 for the same month last year.

Seven permits have been issued in Kitchener, Ont., during the month of January, their value amounting to \$99,600. Most of them are for new factory buildings.

The Toronto Board of Education is calling competitive plans from architects for the new public schools, to be erected on Glen Grove and Glenholme Avenues.

It is stated that a civic heating plant, with heat supplied to citizens at cost, is one of the features of any housing scheme the city of Winnipeg may take up.

The bricklayers of Brantford, Ont., have made a request for 70 cents per hour for this year's schedule, and the Builders' Exchange have agreed to the request.

Heads of local unions in Winnipeg declare that increases in wages for union labor amounting to approximately 20 per cent. will be demanded within the next few weeks.

Fredericton, N. B., is contemplating an expenditure of \$200,000 on permanent pavement, covering a period of five years, half to be raised by direct assessment and half by bond issue.

It is stated that in the past three years 2,518 dwellings have been erected in Toronto, providing accommodation for an increased population of 15,000 in this time. Outside the city limits housing has been provided for 15,000 more.

The Hamilton, Ont., city council has decided that the work of constructing the Kenilworth overflow sewer, authorized by the electorate in January, shall be started as soon as possible, and that the work shall be done by the city on the day labor plan.

John E. Riddell & Son, Limited, has been organized to take over the business now carried on in the city of Hamilton,

Ont., under the firm name of John E. Riddell & Sons. The company is authorized to carry on a sheet metal and rolling business.

The rolling mills of the Canadian Steel Foundries, at Welland, Ont., have been closed down, as a result of the present state of the market. It is stated that there is a possibility that the whole plant may close down in the near future for an indefinite period.

Fyshe & Company, Ltd., has been incorporated with a capital of \$50,000, head office at Montreal. The firm is authorized to act as consulting, designing and production engineers; also to build, construct and operate any public and private works and undertakings, etc.

Toronto machinists decided in favor of a six-hour day at a mass meeting in Massey Hall recently. They would put this order in force immediately in shipbuilding yards and all other public works. There are about 600 skilled mechanics out of work, and by adopting the 6-hour work day labor, there would be a wider distribution.

Applications from every province for the construction of public works, involving an expenditure of \$50,000,000, are before the Government. It has been pointed out that it would be impracticable, under existing financial conditions, for the department to take up many of the schemes, but delegations continue to visit the capital almost daily.

Indications are that the Bedford Construction Co., which has the contract for work at Courtenay Bay, in connection with the St. John Harbor improvement, intends to push this work during the coming season as rapidly as possible. Already this company has six locomotives in service and is arranging for a \$100,000 derrick with which to handle large stones.

The building permits issued in the city of Vancouver during the month of January number 70, and are valued at \$78,197, as compared with 57 for the same month last year, at a value of \$53,125. Last month's total was made up as follows: repairs and alterations, 55, valued at \$16,497; dwelling houses, 9, at \$21,600; factories and warehouses, 5, at \$38,300; one store, \$1,800.

In January of this year there were permits taken out in Toronto for 57 dwellings, at a value of \$117,000. This shows a big increase in this class of construction as compared with last year, when there were permits issued for only 15 dwellings, at a value of \$40,000. In January, 1918, factory construction ran into a considerably greater amount than last month, the figures being respectively \$240,700 and \$50,650.

The Civic Works Committee, of Toronto, is recommending the construction of new pavements and curbs, to cost \$112,995, and has directed Works Commissioner Harris to report on a number of other similar improvements. Front Street is to be paved with granite blocks from John Street to a point 1,600 feet west of Spadina Avenue, as a forced local improvement, which it is estimated will cost, with the curbing, \$84,952.

The Civil Service Association, of Ottawa, is considering a housing scheme for the benefit of those engaged in the Civil Service, and a circular is being sent out to the members of the association to ascertain how many of them are favorable to it. A special housing committee has been working mainly on the idea of a model garden suburb, laid out on modern town planning lines. Advantage is to be taken of the Government's loan.

The Government proposes to spend about \$300,000 on harbor work at Hamilton, Ont., the policy being to provide only for the work that can be completed in a year's time. It is also planned to begin the work of erecting half of the jack-knife bridge at the piers, below the present structure; this

work will cost more than \$100,000, and will take care of traffic until such time as the canal is widened to 300 feet, when the other half of the bridge would be erected.

The Nova Scotia Steel plant at Sydney Mines, N. S., has closed down temporarily. Four batteries of coke ovens will be kept in operation, the remainder being allowed to cool off. During this temporary suspension of operations the open hearths, blast furnaces, stoves and coke ovens will be dismantled and undergo exhaustive repairs. The statement has also been made that the company will probably take advantage of this opportunity of extending their plant.

A deputation from the States of Michigan, Ohio, Wisconsin, Illinois, Minnesota, and Dakota, is taking up with the Federal authorities at Washington, the question of making the Great Lake ports available for ocean shipping. They request that the whole question of developing the St. Lawrence canals for this purpose be referred to the International Joint Commission. A clause, providing for such a reference, has already been attached to the Rivers and Harbors Bill, brought up before Congress at its present session.

A resolution was recently passed by the Kent county council, calling on the Ontario Legislature to inaugurate a more aggressive policy in connection with permanent improvement of roads. It was also urged that the Government should build and maintain provincial highways in consideration of the large revenue from motor licenses and that the grants made by the Government to county-provincial highways should be increased.

Elgin county's appropriation for road work for 1919 is \$102,000, an increase of about \$40,000 over last year. Improvements are to be made on Springer's Hill on the Forge Road No. 46 in Bayham Township, which is stated to be in a dangerous condition. County Road Superintendent Pinea roughly estimates that this work will cost \$26,000—\$6,000 for the building of a culvert and \$20,000 for filling the big cut. A Good Roads Committee has been appointed in Elgin County for the year.

An expenditure of \$50,000 on road work is proposed by the council of Peel County, Ont.

The council of Wellington County, Ont., intends spending a very considerable sum on road repair work, draining, grading, etc., and it is also expected that some fifteen new bridges will be erected. The provincial-county road, which runs from the border of Wentworth County north to Mount Forest, passing through Guelph, will receive special attention, an appropriation of \$25,000 being made for this purpose. Work is also to be carried out on the various suburban roads leading from the city of Guelph, the city, county and government participating in the expenditure.

Attorney-General Johnson gave assurance to a deputation recently that the Manitoba government would give definite consideration to the proposal for the construction of a highway from Winnipeg to the head of the Lakes.

The city of Brantford, Ont., and the county council are petitioning the Government to have work on the provincial highway commenced from Brantford this year.

A mass meeting was recently held in the town of Norwood, Ont., for the purpose of discussing the Good Roads question. The county of Peterboro has not yet fallen in line with the other counties of the province in accepting the provisions of the Ontario Highway Act, and Mr. S. L. Squires, of the provincial Department of Highways, was present to address the meeting and point out the reasons why Peterboro county should adopt a system of roads under this Act. Warden W. A. Anderson, of Otonabee, and Ex-Warden Max Brown, of Asphodel, defended their actions in the county council in refusing to accept the project, the former, how-

ever, stating that he believed the county was going into it, but when it did the council wanted to go as nearly right as they knew how. Mr. Squires read letters from the officials in counties of Hastings, Northumberland and Durham, and Lincoln, expressing their satisfaction with the system and emphasizing its advantages.

"Good Roads" was the subject of chief interest at the recent annual meeting and dinner of the Ottawa Motor Club. Mr. Thos. Ahearn, retiring president of the club, referred to the agitation for the abolition of toll roads, reminding his hearers that in the whole province of Ontario there were but some 50 miles of toll roads, but 40 of that 50 were to be found near the city of Ottawa. With the assistance of the Mayor and others who had interested themselves, they were now likely to get rid of them, however.

His Worship Mayor Fisher also spoke briefly, emphasizing the necessity for good roads and expressing his pleasure that the old toll system was to be done away with.

Another speaker was Mr. George Hogarth, chief engineer of the Ontario Highway Department, who gave an interesting address on road building, illustrated by lantern slides and motion picture films, showing the construction of macadam and asphaltic concrete roadways, and also views of the Toronto-Hamilton highway.

Personals

Mr. W. Walker has been appointed division engineer, Eastern Lines, G. T. Ry., succeeding Major Bond, who was promoted to chief engineer.

Mr. Ronald G. Starr, of Toronto, has been appointed engineer of the Orillia Water and Light Commission, in succession to the late W. K. Greenwood.

Mr. Andrew McCulloch, chief engineer of the Kettle Valley Railway Co., in British Columbia, has now been made acting superintendent, taking the place of Mr. J. W. Mulhern, who has resigned.

Major Clifford Thackwell Trotter, Canadian Engineers, son of Mr. W. C. Trotter, president and general manager of the Standard Clay Products, Limited, St. Johns, P. Q., and New Glasgow, N. S., has received the D. S. O. for conspicuous gallantry in the field.

Mr. Wm. Storrie, chief engineer of the John ver Mehr Engineering Co., Ltd., is now in charge of the rebuilding of the mole at Zeebrugge, Belgium. The British Government has awarded a number of contracts to this company for reconstruction work in that part of Belgium.

Capt. Lucius E. Allen, who, it will be recalled, was appointed as consulting engineer to the Nitrate Division, Ordnance Department, U. S. Army, last September, is now returning to Belleville, Ont., to take up his former work as a consulting engineer and also engineer of Hastings County.

Mr. Mark Workman, president of the Dominion Steel Corporation sailed for England recently, the main object of his trip being to endeavor to secure steel orders for export to Europe. Mr. Workman is optimistic regarding the prospects of the operations of his company's big plant at Sydney.

Mr. W. G. Chace, Chief Engineer of the Greater Winnipeg Water District, recently addressed a meeting of the Manitoba Branch of the Sanitary Engineers' Institute of Western Canada, in Winnipeg. He pointed out that repeated tests had proven the water to be pure and declared that it should be as cool as the present supply. He also told how it would take anywhere between one and a half and three days for the water to come from the lake to the city. It would be taken from 19 feet below the lake level, and it was not expected that it would be necessary to use any chemicals for purification purposes.

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Clearing Houses Also Needed for Technical Men

THE Canadian Government is establishing employment bureaus all over Canada—some 65 in all—which will, in effect, act as clearing houses where employers requiring labor and laborers looking for employment may get in touch with one another. Apparently, however, the scheme was not designed for any particular class, or perhaps it would be nearer the fact to say it was only designed for one class, namely, the laborer, who, on account of his greater numbers and his natural limitations for getting in touch with any employment except that nearest at hand, naturally will monopolize the government's efforts. Yet there are other classes of returned men for which it is just as essential that provision be made. Indeed insofar as the development work of the country is concerned it is of the very greatest importance that men of constructive ability should be utilized as soon as possible, as their work must necessarily precede that of the mechanical trades. For this reason it is urgent that engineers and technical men, men with construction experience or who have held positions which developed organization ability, should be

given congenial employment the very moment they are discharged from military service. Aside from the fact, of course, that the members of the mechanical trade must be fed and clothed their employment necessarily follows by a few weeks, or months, as the case may be, the employment of the man with technical or organization training.

One cannot but realize that the plan of the government is incomplete so far as the professional man is concerned. We understand that representations are being made in the proper quarters to have the weak points in the plan strengthened up. The proposals will no doubt take cognizance of the fact that the technical man is not quite so local in his activities, which will make it less necessary to have the offices close together—probably one or two in each province will be sufficient. These, doubtless, should be in charge of technical men who have been overseas. The immediate work of these officials would seem to be the obtaining of a list of positions vacant from municipalities, private corporations, and others requiring the services of technical men, and a compilation of the experience technical training, record, etc., of the men whose services are at disposal.

It must be remembered, however, that the success of any such scheme as this is dependent upon demand for men being equal to the supply. At the present moment this does not appear to be the case. The government has said definitely "We will see that there is no unemployment." So far they have not lived up to this promise and the establishment of employment bureaus when there is no employment is not a solution.

C. P. R. Proposes New Work

M. R. D. C. COLEMAN, vice-president of the C.P.R., recently gave out a statement regarding the work proposed to be undertaken on the western lines of that road during the year. His statement was as follows:

"New station buildings will be erected at Harding, Man.; Marchwell, Schwitzer, Rutland and Dafoe, Sask.

"The engine houses at Weyburn, Moose Jaw, Sask.; and Cranbrook, B.C., will be extended, and the engine house at Sirdar, B.C., will be rebuilt.

"The interior of the station at Medicine Hat will be re-modelled.

"To accommodate the largest type of locomotives, new turntables will be installed at Moose Jaw, Field, and Revelstoke.

"The work of lining Connaught tunnel, in the Selkirk Mountains, with concrete will be continued.

"An additional transfer barge will be built for Okanagan Lake, and an additional car slip provided.

"A permanent concrete floor will be placed in the stockyards at Fort William, and improvements also made in the stockyards at Moose Jaw.

"Winnipeg Beach betterment, with a view to securing better accommodation for the public.

"Coaling plants will be built at Raith, Ont., and North Bend, B.C.

"Additional trackage for handling train movements will be provided at High Bluff and Rosser, Man.; Fusilier, Stephen, Melita, Man.; and Rosetown, Sask., and extensions made to terminal trackage at Portage la Prairie, Revelstoke and Vancouver.

"Locomotive boiler wash-out plants of the most

modern design will be installed at Medicine Hat and Revelstoke.

"Very extensive improvements will be made at Winnipeg Beach with a view to giving better accommodation to bathers and picnickers. These improvements include the erection of a new power house, new bathing houses and the removal to a new site and re-erection of a number of the present buildings, and it is expected that the change will greatly promote the amenities of the pleasure resort.

"The work to be done on bridges will be most extensive. The most interesting work of this nature to be undertaken will be the replacement of the bridge over the Assiniboine at St. James, and the filling of the great structures over Scissors Creek and Bear Creek on the Neudorf line and the large bridge over the Battle River at Hardisty.

"At Winnipeg station the temporary wooden platforms in the train shed, which were put into service until the fill had reached its permanent location, will now be replaced with permanent mastic platforms.

Engineers' Club of Toronto

THE annual meeting of the Engineers' Club of Toronto was held in the Club building, 90 King St. West, on Thursday, February 6th. The reports presented covering the operations during the year 1918 were very satisfactory. The membership is 566, showing an increase over the pre-



Mr. J. R. W. Ambrose
President-elect of Engineers' Club of Toronto

vious year. Mr. L. V. Rorke, the retiring president, reviewed briefly the work of the Club and spoke hopefully of the future, making special reference to the expected early return of a large number of members from overseas.

The following are the officers and directors for the current year: President, J. R. W. Ambrose; 1st vice-president, Melville P. White; 2nd vice-president, Tracey D. LeMay; 3rd vice-president, J. B. Carswell; directors, William A. Bucke, A. B. Cooper, E. G. Hewson, Charles H. Heys, Arthur L. Hull, J. H. McKnight, Walter R. McRae, L. V. Rorke, James R.

Wainwright, Major Ward Wright, T. S. Young; secretary-treasurer, R. B. Wolsey.

Mr. L. V. Rorke is chairman of the Admission Committee; Mr. W. A. Bucke, chairman Finance Committee; Mr. T. S. Young, chairman House Committee; Mr. J. B. Carswell, chairman Library Committee. At the suggestion of the President-elect, a committee was also appointed to advise returned members regarding available positions in the engineering field, and another committee on the welfare of the engineering profession.

First Directors' Meeting of Montreal Association of Building and Construction Industries

The first meeting of the Board of Directors of the newly organized Montreal Association of Building & Construction Industries was held in their quarters in the Drummond Building last week. Mr. W. M. Irving, president, who occupied the chair, welcomed the old members who had been re-elected. The services they had rendered in the past to the old Exchange had been appreciated by the members, and he well knew from past experience that he could depend upon their loyalty, support and co-operation. He invited the new members to step right in and get to work at once. In the committees which he would name he had taken care that the new members would be fairly distributed among them, so that they could take an active part from the start. He accordingly nominated the following committees: Membership, Messrs. Donald Church, convenor, F. J. Parsons and John Grieve; Audit, Messrs. R. F. Dykes, convenor, Fred B. Locker and A. K. McNutt; Rooms and Rules, Messrs. E. B. Evans, convenor, A. W. Bremner and James Griffin.

It was also agreed that the Committee on the Building By-laws of Westmount, viz.: Messrs. John Quinlan, J. P. Anglin, W. R. J. Hughes, and W. M. Irving, and that on the By-laws and Constitution of the new organization, viz.: Messrs. J. E. Walsh, R. F. Dykes and W. M. Irving, be continued.

A request from the Bricklayers' and Stonemasons' International Union that an agreement be drafted for the coming season was referred to the General Contractors' and Trade Contractors' Sections. Arising from this it was moved by Mr. J. P. Anglin, seconded by Mr. John Grieve, and unanimously resolved that a committee of three be appointed to study the whole subject of agreements with labor unions with special reference to the underlying principles of these and to the reasons why so many labor unions do not become incorporated, and the following committee was appointed: Messrs. Anglin, Locker and Grieve. A communication from Mr. Joseph Fabien, contracting plasterer, Verdun, on the lack of the apprenticeship system in Montreal was referred to the same committee.

President Irving, Past President Anglin, and Mr. A. S. Daly were appointed to co-operate with other organizations in assisting the Administrative Commission of the city to prepare details of the housing scheme for the Provincial Government.

It was agreed to have a banquet in the near future to which would be invited all members of the building fraternity in the city and district of Montreal.

Mr. D. K. Trotter was unanimously re-elected secretary.

Tests Determine Strength of Brickwork

Report of Comprehensive Series of Tests Carried Out at Toronto University in Co-operation With City Architect's Department

By W. W. Pearse, C.E., City Architect, Toronto*

AT the present time Toronto's Building Department is busy revising their building by-law. When the chapter on Brickwork was reached it was found that the data available on Canadian brickwork was very meagre. The brick manufactories that supplied the Toronto market kindly consented to allow the Building Department to visit their plants and select bricks and have them tested. The results are tabulated in Table I, sheets (a), (b) and (c). By referring to the table you will notice that the first column gives certain numbers. These numbers are the key to the manufacturer's name, which is held confidential. The bricks selected were not the best bricks manufactured by the different companies, but the type that was usually used as backing bricks, and only in a few cases did we select face or very hard bricks, as usually that type of brick is only used for facing.

It was found that absorption entered into the strength of brick in compression. Bricks having an absorption of 12 per cent. and under were on an average of about 38 per cent. stronger in compression and 85 per cent. stronger in bending than the average brick absorbing more than 12 per cent. of moisture.

Determining Relation Between Individual Brick and Brick Piers

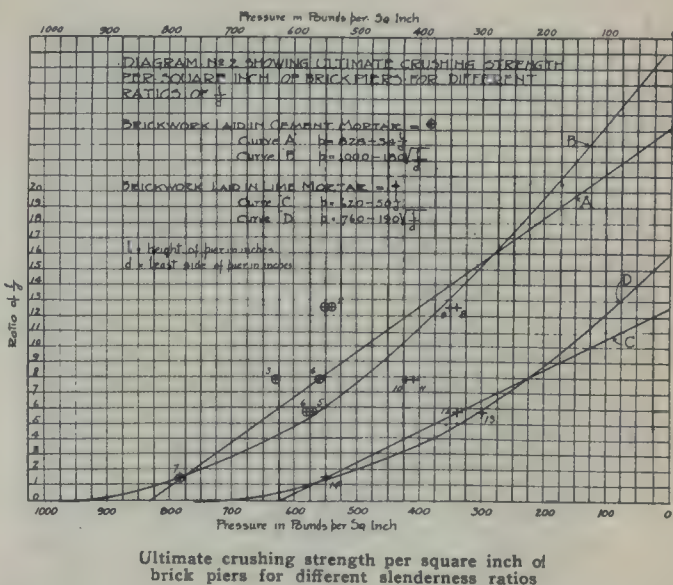
After the tests were made, as shown in Table I, sheets (a), (b) and (c), it was then thought advis-

strength of brick piers for different heights. It was also decided to let the piers set for a period of about three months, as this was considered the least time that the walls would be called upon to take their full load. It was also decided to build the piers in both lime and cement mortar of the following mixtures:

Cement Mortar.—1 part Portland cement, 3 parts of sand and $\frac{1}{4}$ part of hydrated lime, all by bulk.

Lime Mortar.—1 part lime to 3 parts of sand.

The piers were laid up during the month of June by an experienced bricklayer. They were 8 $\frac{5}{8}$ inches square in plan and were built so as to represent a portion of an ordinary brick wall, one brick thick, bonded by headers every sixth course, according to common practice in the City of Toronto. In constructing



the piers an effort was made to obtain a class of workmanship neither better nor worse than would be expected from men of ordinary skill. The crushing strengths of individual bricks and of cubes of mortar six inches to a side, (the latter at an age of approximately three months) are as follows:

Modulus of rupture of individual bricks, 165 lbs per square inch.

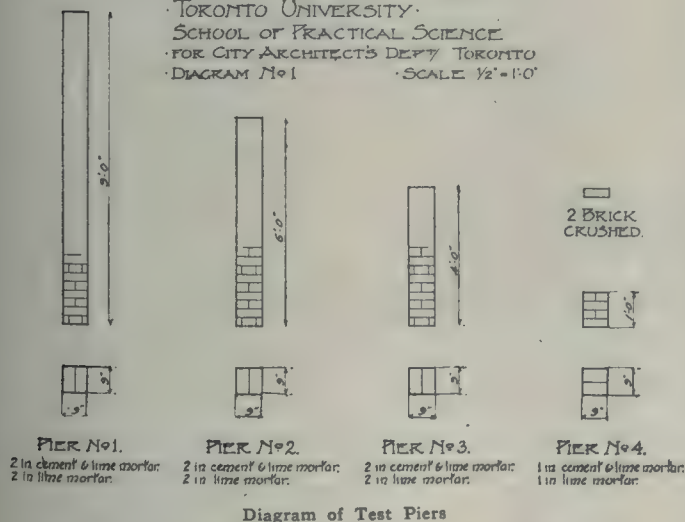
Crushing strength of individual bricks, 1,000 lbs. per square inch.

Crushing strength of lime mortar, 235 lbs. per square inch.

Crushing strength of cement cubes, 1,835 lbs. per square inch.

The piers were constructed on the 200,000 pound Richelie testing machine in the Strength of Materials Laboratory at the University of Toronto, under the direction of Peter Gillespie, Esq., Assoc. Professor of Applied Mechanics. Each pier was built on a plate of $\frac{1}{4}$ inch steel, 13 inches square as a base, and capped in plaster of Paris. In addition to the crushing strength

RE TEST ON BRICKWORK AT
 TORONTO UNIVERSITY
 SCHOOL OF PRACTICAL SCIENCE
 FOR CITY ARCHITECT'S DEPT. TORONTO
 DIAGRAM No. 1 SCALE $\frac{1}{2}" = 1'-0"$



able to try and arrive at a relation between the individual brick and brick laid up in piers, so a representative from the department selected one of the poorest types of brick from one of the leading manufacturers and they kindly donated the bricks to build fourteen piers of different heights, the object being to derive a curve, if possible, that would give the

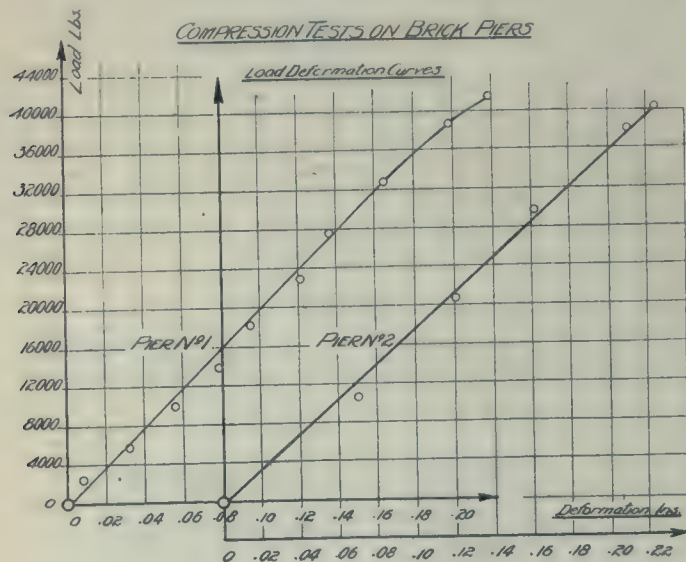
*Paper given before Building Officials' Conference of the United States and Canada and the National Brick Manufacturers' Association of the United States of America, at Pittsburgh, Pa., on February 7th, 1919.

of each pier the amount of shortening due to load and the lateral deflection, if any, were obtained.

Relation Between Strength and Slenderness

As mentioned before the investigation was to determine, if possible, the relation between strength and slenderness and for that reason values of the ratio of length to diameter lying between 1.4 and 12.5 were provided for in the programme by varying the length from 1 to 9 feet. A course of bricks, including mortar joints, averaged 3 in. in depth. See diagram No. 1.

Referring to diagram No. 2 it will be noticed that points have been plotted for different ratios of 1/d



and then a straight line formula has been plotted for the cement piers, namely:

$$p = 828 - 34 \frac{1}{d}. \text{ See straight line A.}$$

where p = ultimate pressure per sq. in.

l = length of pier in inches.

d = thickness of piers in inches.

A parabolic curve has also been plotted, making the curve tangent at 1,000 lbs. (ultimate crushing strength of the individual brick) and the least crushing strength of pier No. 5, whose slenderness ratio is $1/d = 5.7$ and crushing strength per square inch of 570 lbs., or

$$p = 1000 - 180 \sqrt{1/d}. \text{ See curve "B," Diagram No. 2.}$$

It will be noticed that the straight line A passes through the point plotted for pier No. 4, having a crushing value of 560 lbs. per sq. in. and the point plotted for pier No. 7 having a crushing value of 780 lbs. per sq. in.

The piers built in lime mortar will now be considered.

Referring to diagram No. 2, straight line C has been drawn through the point plotted for pier No. 14, having a crushing value of 550 lbs. per sq. in. and then through point plotted for Pier No. 13. The equation for this straight line is

$$p = 620 - 50 \frac{1}{d}.$$

A parabolic curve, $p = 760 - 190 \sqrt{1/d}$ has been passed through the points plotted for piers No. 14 and No. 13.

Johnson, Bryan, Turneure, in Modern Framed Structures, Part III, suggest a parabolic equation for the strength of columns and by referring to Diagram

No. 2 it will be seen that it agrees well with tests.

Load deformation curves have been plotted and from these the modulus of elasticity (E) of the masonry was found.

The area beneath the curve is a measure of the work done in producing failure and if this when done be divided by the volume of the pier, the result will be analogous to the common "coefficients of resilience." This is used to measure the capacity of the material or structure to resist shock, or

$$R = \frac{p^2}{2E} \quad \text{where}$$

R = the ultimate resilience per unit of volume.

p = strength of the material, and

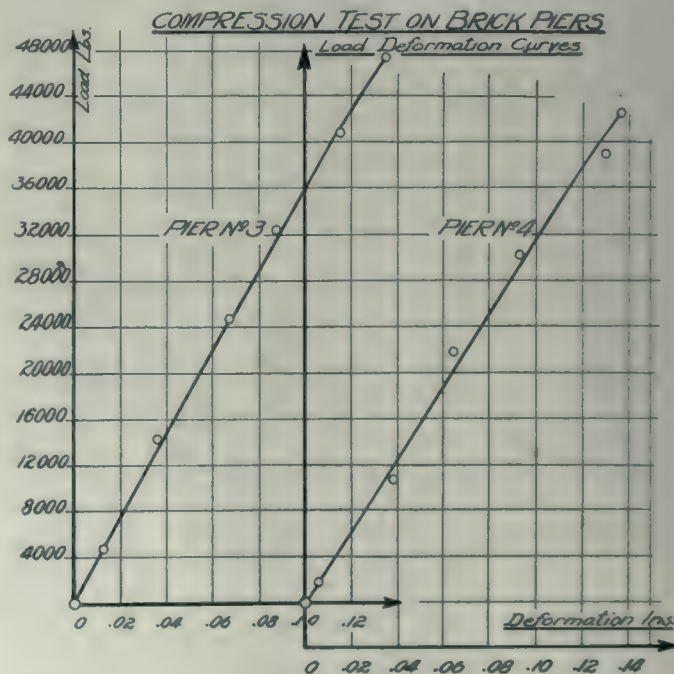
E = the modulus of elasticity.

For the twelve piers observed, this coefficient has been worked out in inch pounds per cubic foot, with the following as the values:

Pier	Mortar	Resistance to Shock.
1	Cement	955 in. lbs. per cu. ft.
2	"	950 do
3	"	1075 do
4	"	970 do
5	"	1215 do
6	"	1060 do
	Average	1040 do
8	Lime	565 do
9	"	525 do
10	"	645 do
11	"	715 do
12	"	867 do
13	"	630 do

Average — 650

The resistance to shock is 60 per cent. greater where cement mortar is used than where lime mortar is employed.



Crushing Strength.—The following table gives the observed values of the crushing strength for the fourteen piers tested:

Pier	Cement Mortar Strength	Pier	Lime Mortar Strength
1	550 lbs. per sq. in.	8	340 lbs. per sq. in.
2	540 " " " "	9	350 " " " "

3	630	"	"	"	"	10	420	"	"	"	"
4	560	"	"	"	"	11	410	"	"	"	"
5	570	"	"	"	"	12	340	"	"	"	"
6	580	"	"	"	"	13	300	"	"	"	"
7	780	"	"	"	"	14	550	"	"	"	"

22,800	.120
27,600	.134
32,700	.163
38,600	.196
41,200	failed

Pier No. 2

Tested September 28th, 1918.

Age, 108 days.

Height, 9 ft. 0¼ in. = 36 courses.

Mortar, Cement.

E = 264,000 lbs. per sq. in.

Strength = 77,800 lbs. per sq. ft. = 540 lbs. per sq. in.

1/d = 12.5.

Load, lbs.	Deformation, inches.
000	.000
1,200	.000
10,800	.068
20,800	.119
29,400	.160
38,000	.208
40,200	failed

Pier No. 3

Tested October 3rd, 1918.

Age, 108 days.

Height, 5 ft. 7½ in. = 22 courses.

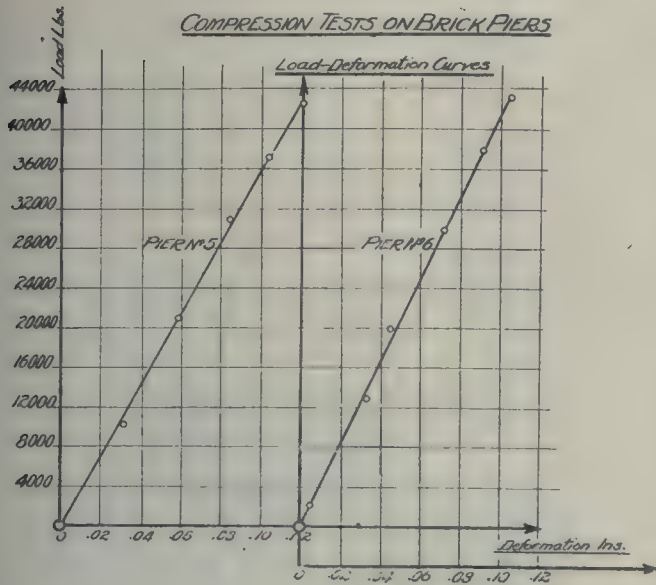
Mortar, Cement.

E = 330,000 lbs. per sq. in.

Strength = 91,000 lbs. per sq. ft. = 630 lbs. per sq. in.

1/d = 7.8.

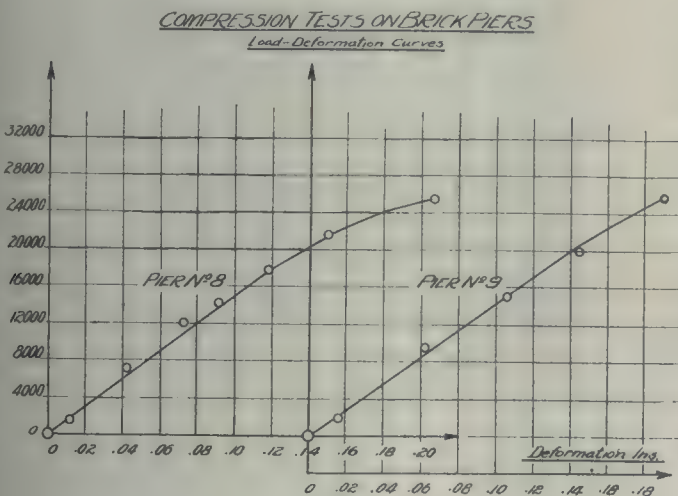
Load, lbs.	Deformation, inches.
000	.000
4,600	.012
14,200	.036
24,600	.066
32,200	.087
40,800	.114
47,000	failed



The average strength of the cement mortar series is nearly 60 per cent. greater than the average strength of the lime mortar series.

These tests were witnessed wholly or partially by Messrs. Sykes, Carter and Steen, of the City Architect's Department, City of Toronto.

The test records follow:—

**Pier No. 1**

Tested September 25th, 1918.

Age, 105 days.

Height, 9 ft. 0¼ in. = 36 courses.

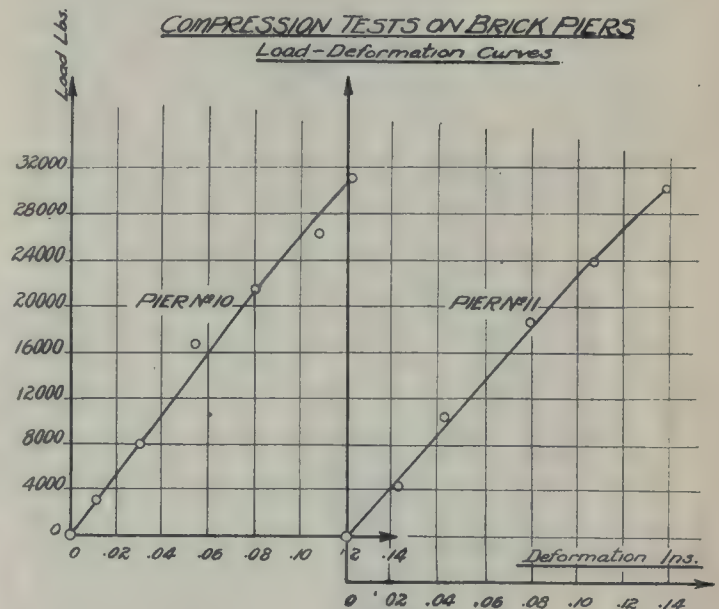
Mortar, Cement.

E = 294,000 lbs. per sq. in.

Strength = 79,600 lbs. per sq. ft. = 550 lbs. per sq. in.

1/d = 12.5.

Load, lbs.	Deformation, inches.
000	.000
2,500	.008
5,800	.032
10,000	.056
13,800	.079
18,200	.094

**Pier No. 4**

Tested October 7, 1918.

Age, 112 days.

Height, 5 ft. 7½ in. = 22 courses.

Mortar, Cement.

E = 284,000 lbs. per sq. in.

Strength = 81,000 lbs. per sq. ft. = 560 lbs. per sq. in.

1/d = 7.8.

Load, lbs.	Deformation, inches.
000	.000
1,600	.005
10,700	.037
21,600	.063
29,800	.092
38,600	.129
41,800	failed

Pier No. 5

Tested, October 8th, 1918.

Age, 112 days.

Height, 4 ft. 1 in. = 16 courses.

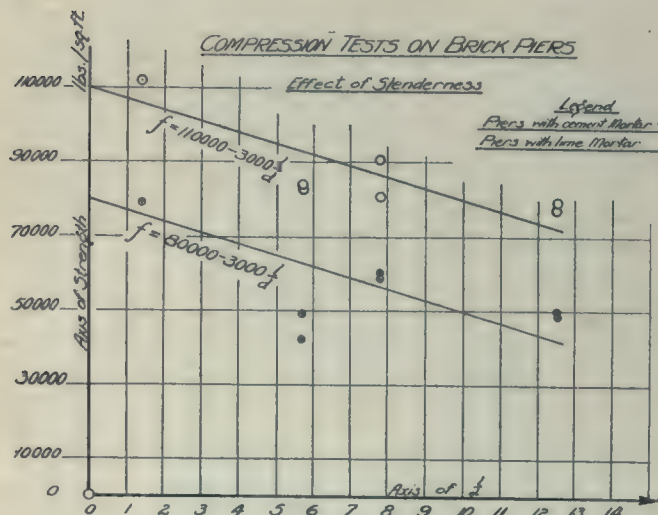
Mortar, cement.

E = 234,000 lbs. per sq. in.

Strength = 82,700 per sq. ft. = 570 lbs. per sq. in.

1/d = 5.7.

Load, lbs.	Deformation, inches.
000	.000
800	.000
10,400	.032
21,000	.059
31,000	.084
37,200	.103
42,600	failed

**Pier No. 6**

Tested October 8th, 1918.

Age, 112 days.

Height, 4 ft. 1 in. = 16 courses.

Mortar, cement.

E = 276,000 lbs. per sq. in.

Strength = 83,700 lbs. per sq. ft. = 580 lbs. per sq. ft.

1/d = 5.7.

Load, lbs.	Deformation, inches.
000	.000
2,200	.005
13,000	.033
20,000	.045
30,000	.071
38,000	.090
43,200	failed

Pier No. 7

Tested September 25th, 1918.

Age, 107 days.

Height, 12 1/8 ins. = 4 courses.

Mortar, cement.

Crushing strength = 58,000 lbs. = 112,000 lbs. per sq. ft.

= 780 lbs. per sq. in.

E was not determined. 1/d = 1.4.

Pier No. 8

Tested, September 26th, 1918.

Age, 107 days.

Height, 9 ft. 1/8 in. = 36 courses.

Mortar, lime.

E = 215,000 lbs. per sq. in.

Strength = 49,200 lbs. per sq. ft. = 340 lbs. per sq. in.

1/d = 12.5.

Load, lbs.	Deformation, inches.
000	.000
1,600	.012
7,200	.042
12,000	.073
14,200	.091
17,800	.118
21,600	.150
25,400	.207 failed

Pier No. 9

Tested, Sept. 27th, 1918.

Age, 108 days.

Height, 9 ft. = 36 courses.

E = 208,000 lbs. per sq. in.

Mortar, lime.

Strength = 50,000 lbs. per sq. ft. = 350 lbs. per sq. in.

1/d = 12.5.

Load, lbs.	Deformation, inches.
000	.000
2,000	.016
9,400	.062
15,200	.106
20,000	.144
25,800	failed

Pier No. 10

Tested, October 1st, 1918.

Age, 110 days.

Height, 5 ft. 7 1/2 in. = 23 courses.

Mortar, lime.

E = 242,000 lbs. per sq. in.

Strength = 60,500 lbs. per sq. ft. = 420 lbs. per sq. in.

1/d = 7.8.

Load, lbs.	Deformation, inches.
000	.000
3,000	.012
8,200	.030
16,800	.054
21,800	.079
31,200	failed

Pier No. 11

Tested, October 2nd, 1918.

Age, 111 days.

Height, 5 ft. 7 1/2 ins. = 23 courses.

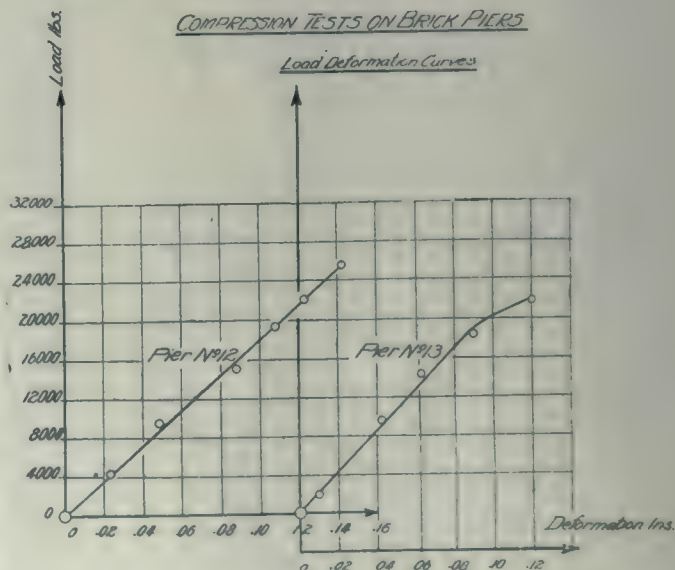
Mortar, lime.

E = 214,000 lbs. per sq. in.

Strength = 59,300 lbs. per sq. ft. = 410 lbs. per sq. in.

1/d = 7.8.

Load, lbs.	Deformation, inches.
000	.000
4,600	.022
10,600	.042
19,000	.078
24,200	.105
30,600	failed

**Pier No. 12**

Tested, September 21st, 1918.

Age, 94 days.

Height, 4 ft. 3/4 in. = 16 courses.

Mortar, lime.

E = 119,000 lbs. per sq. in.

Strength = 49,600 lbs. per sq. ft. = 340 lbs. per sq. in.

1/d = 5.6.

Load, lbs.	Deformation, inches.
000	.000
4,500	.023
9,500	.048

15,300	.088
19,600	.108
22,200	.123
25,600	failed

Pier No. 13

Tested, September 21st, 1918.

Age, 94 days.

Height, 4 ft. $\frac{7}{8}$ in. = 16 courses.

Mortar, lime.

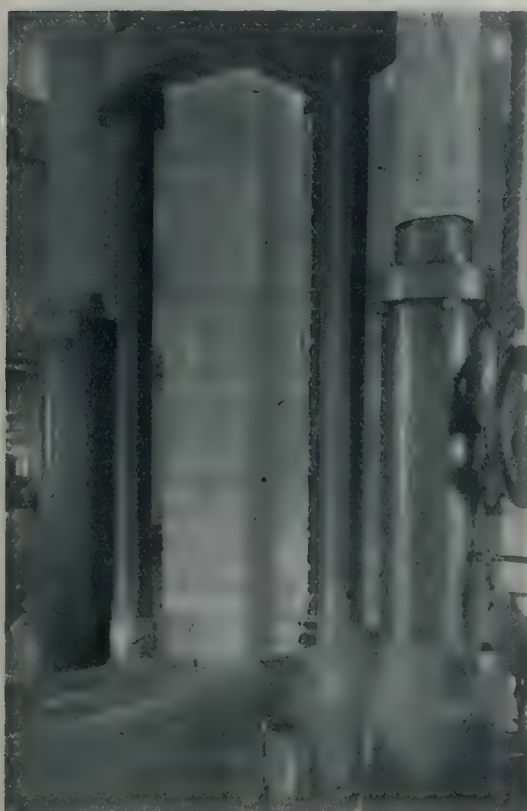
E = 142,000 lbs. per sq. in.

Strength = 24,700 lbs. per sq. ft. = 300 lbs. per sq. in.

1/d = 5.6.

Load, lbs.	Deformation, inches.
000	.000
2,000	.010
9,400	.042
14,400	.063
18,300	.089
21,000	.119
22,000	failed

first cracks, 7th and 8th from bottom.



Brick Pier undergoing test at Toronto University

Pier No. 14

Tested, September 21st, 1918.

Age, 95 days.

Height $12\frac{1}{8}$ in. = 4 courses.

Mortar, lime.

Crushing strength = 40,800 lbs. = 79,200 lbs. per sq. ft.

= 550 lbs. per sq. in.

E was not determined.

Summary

1. The strength of the strongest pier laid in cement mortar was 78 per cent. of the strength of the individual brick.

2. The strength of the strongest pier laid in lime mortar was 55 per cent. of the strength of the individual brick.

3. Brick masonry laid in cement mortar is about 50 per cent. more rigid and 60 per cent. stronger than that laid in lime mortar, and the resistance to shock is 60 per cent. greater in the former than the latter.

4. Longitudinal or vertical rupture through bonding courses occurred very frequently.

5. No appreciable shrinkage in height could be observed during the first month after construction. After this period, measurements were discontinued.

6. Lateral deflections under load were in most cases so small as to be almost incapable of measurement with a scale divided into 100th of an inch.

7. As a result of the tests, the following formulas for the strength of brick piers in lbs. per sq. inch are suggested. The former is for cement and the latter for lime masonry:—

$$P = 828 - 34 \text{ 1/d.}$$

$$P = 620 - 50 \text{ 1/d}$$

Professor Gillespie proposed the following formulae for the strength of brick piers in lbs. per sq. foot:

$$P = 110,000 - 3,000 \text{ 1/d cement mortar, and}$$

$$P = 80,000 - 3,000 \text{ 1/d lime mortar.}$$

Some very valuable tests were made by the Department of Commerce, Technologic Papers of the Bureau of Standards, No. 111, Washington, D.C. The tests were made on large brick piers and a general survey was made of all previous tests conducted on the subject.

In having the tests made at the Toronto University I had in view trying to get up a curve or straight line that would be reasonably safe to be used for different ratios of 1/d, but the few tests made, of course, would not warrant anything definite, but I hope this year to have a great number of brick piers tested so that a reasonable formula for brick work may be arrived at.

It is also the intention to have tile piers tested of the same lengths as those of the brick, and in this way it will be possible to get at a comparison of the strength of tile piers and brick, and any other building material will be treated the same way, so that the Department may take brick as a unit and the different materials may be considered either above or below in value.

Prospects for Development of Steel Industry on the Coast

THE British Columbia Advisory Committee for Scientific and Industrial Research has reported to the Research Council at Ottawa the preliminary results of an investigation into the possibilities of fulfilling, as it did, the hopes and visions of many years. of developing an iron and steel industry on the Pacific coast. The general conclusion reached is that there is room for one large plant, provided it is assured of the whole Pacific coast market, but that economic conditions of manufacture and marketing preclude, under present conditions, the establishment of more than one plant. No large quantities of iron ore have been so far blocked out at one place in British Columbia. There are now two rolling mills operating in British Columbia using scrap iron and steel, and there is a prospect of starting an electric smelting furnace for the magnetite iron ore on a comparatively small scale in connection with other electro-chemical industries.

There does not seem to be, however, much likelihood of the iron and steel industry ever being developed on the Pacific coast to any large extent.

General Contracting Firm Organized

Joseph Giroux, Limited, St. Casimir, P. Q., has been formed with a capital stock of \$30,000 to carry on the business of general contractors.

7th Annual Meeting of Provincial Builders and Supply Association Held at Chatham

THE Seventh Annual Convention of the Provincial Builders' & Supply Association of Ontario was opened in Chatham, Ont., on Tuesday, Feb. 11th, and the session lasted three days. Many reforms were advocated, and business of particular interest to those connected with the building or allied industries was thoroughly discussed. It was clearly shown that the need of the industrial world to-day is the application of technically trained intelligence.

The session opened with President A. Tomlinson in the chair. Mr. Tomlinson has recently withdrawn from active operation in the field of building or construction endeavor and has decided to devote his efforts in the future to the work of agriculture on quite a large scale. While Mr. Tomlinson was the recipient of numerous congratulations and expressions of good wishes from his old associates, yet considerable regret was felt by the whole association in his retirement.

In his opening address Mr. Tomlinson said: "In presenting my report for 1918 I feel like a back slider, inasmuch as, while I am presiding at your convention here, I have decided to change my occupation.

"At our executive meeting in Toronto, the execu-

ticularly affecting their own interests, to the detriment sometimes of the best interests of the sub-contractors of supply men. In my opinion, it would be to the interest of all if many of these distinctions were not drawn as we are all striving for the one goal. I am also of the opinion that to make the Dominion Association a success a strong provincial association is necessary, as each province has its own peculiar



Retiring President A. Tomlinson, Chatham



Herbert Elgie, of Toronto, President elect for 1919

tive and the Lien Law Committee waited on Hon. Mr. Lucas, in a body, regarding the changes in the Lien law and the committee was somewhat disappointed in the stand Mr. Lucas took, which differed radically from his expressed views at the previous interview. However, the committee has been going into the subject very carefully and we may expect a report from them of considerable interest along with the reports from the other committees.

"While attending the convention in Ottawa, I noticed a tendency on the part of the general contractors to give the most careful consideration to details, par-

troubles, which can be better solved by themselves. I am also of the opinion that the headquarters of this association should be at Toronto.

"I am sorry I cannot report any exchanges coming into the fold during the past year, but you must remember that there has been a war on, and now that it is over there is a greater need than ever before for organization. In the past there has been talk of reducing the dues. This, in my opinion, would be unwise; if any change is contemplated it should be in the nature of an increase.

In conclusion, let me express the wish that your stay in the Maple City will be a pleasant one, and that you will return home determined to make this year a successful one in your business and in your own exchange.

Secretary's Report

Mr. T. R. Wright, of London, then submitted his report as secretary. In opening, he pointed out that a request from the meeting in Galt last June, that a copy of the minutes of the convention be sent to each exchange, was carried out by the secretary, who had done everything possible to keep the members of the different exchanges in touch with what was going on in the Province since the June meeting. "I would here suggest," he continued, "that whoever is elected secretary for 1919 get, say, 1,000 copies of this form, which I submit for your consideration, printed, and on the first of every month he send a

blank to each exchange to be filled in and returned to the secretary so that he will be able, from his files, to give any exchange in the province an answer to any enquiries as to trade or conditions, etc. This, I trust, will be acted on by all our exchanges.

"I will not attempt to go into the details as to the advantages to be gained by the building and construction industries of the country now that the war is about settled.

"Referring to the Board of Directors meeting, held in Toronto on Sept. 3, 1918, you will see by the report that your directors have been active in bringing before parliamentary representatives the need of some changes in the laws regarding the improvement of facilities for protection for the contractor. One question to come up at this convention is the question of some change in the Lien Law, which, as it at present exists, is of very little protection to the trade against men who are not strictly honest. We hope to be able to show our representatives the wisdom of the proposed changes.

"As to the building trade, it will, in my opinion, be in a more or less unsettled condition for the next two years on account of supply and demand, and the condition of the trades unions. These will be questions worthy of our consideration as delegates to this convention."

Monthly report form suggested by the Secretary, Mr. T. R. Wright, of London, in his address to the convention:

Report for	From	Exchange
Trade conditions		
Brick Work		
Carpenter Work		
Painting		
Plastering		
Plumbing		
Tinsmithing		
Electric wiring		
Supplies		
Labor Conditions		
Wages		
Condition of Exchange		
Remarks		

The following committees were appointed by the president: Technical Education—E. R. Dennis, London; W. E. Dillon, Toronto; L. C. Reynolds, Toronto. A committee to enquire into the organization of the Association of Canadian Building & Construction Industries—A. H. Dancy, Toronto; Herbert Elgie, Toronto; and Mr. Hannaford, Hamilton, with A. T. Enlow, of the same city, as an alternative.

Tuesday's Session—Report of Lien Law Committee

Mr. Gander presented the report of the Lien Law Committee, in which the following amendment to the Mechanics' and Wage Earners' Lien Act was submitted for the consideration of the delegates:

An Act to Amend The Mechanics' & Wage Earners' Lien Act

"His Majesty by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:—1. Sub-section 2 of Section 22 of the Mechanics' and Wage Earners' Lien Act is amended by adding after the word "materials" in the first line thereof the words, "in case not otherwise provided for."

2. Section 22 of the said Act is amended by adding thereto the following sub-sections:—

(6) If, within the time mentioned in sub-section 1, a sub-contractor has given to the owner or, in the

case of a contract which is under the supervision of an architect, engineer or other person upon whose certificate payments are to be made, to such architect, engineer or other person, notice in writing of the sum owing to each sub-contractor, claim may be registered within seven months after the time mentioned in sub-section 1.

(7) If, within the time mentioned in sub-section 2, any person who furnishes or places any materials, has given to the owner, or in the case of a contract which is under the supervision of an architect, engineer or other person on whose certificate payments are to be made, to such architect, engineer or other person, notice in writing of the sum owing to such person by the owner or by the contractor or by a sub-contractor, as the case may be, the claim for a lien for such sum by such person may be registered within seven months after the time mentioned in sub-section 2.

3. Section 42 of the said Act is hereby repealed and the following substituted therefor:—

42. The costs of the action awarded to the plaintiffs and



John Hildrith, Chatham, 2nd Vice-president

successful lien holders shall be apportioned and borne as the Judge or officer may direct, and such costs, exclusive of actual disbursements, shall not exceed the percentages hereinafter mentioned, viz.: 25 per cent. of the total amount awarded by the judgment where such amount does not exceed \$1,000.

20 per cent. of the amount awarded in excess of \$1,000 and up to \$2,000.

15 per cent. of the amount awarded in excess of \$2,000 and up to \$3,000.

10 per cent. of the amount awarded in excess of \$3,000, and up to \$4,000.

5 per cent. of the amount awarded in excess of \$4,000.

4. Section 43 of the said Act is repealed and the following substituted therefor:—

43. Where costs are awarded against a plaintiff or other persons claiming liens, such costs shall be apportioned and borne as the judge or officer may direct and shall not exceed in the aggregate the percentages hereinafter mentioned, viz.:—

25 per cent. of the total amount of the claims of the

- parties or persons against whom costs are awarded where such amount does not exceed \$1,000.
- 20 per cent. of the amount of said claims in excess of \$1,000 and up to \$2,000.
- 15 per cent. of the amount of said claims in excess of \$2,000 and up to \$3,000.
- 10 per cent. of the amount of said claims in excess of \$3,000 and up to \$4,000.
- 5 per cent. of the amount of said claims in excess of \$4,000."

This report aroused considerable discussion and resulted in a motion by Mr. R. Marson, of Stratford, seconded by Mr. Gibbons, of London, that the convention endorse the amendment to the Lien Law as approved by the Provincial Builders' & Supply Association of Ontario and that a copy of the amendment be sent to Mr. Joe Russell, M.P.P. This motion was carried unanimously.

Mr. Herbert Elgie, of Toronto, spoke at length on the work carried on by the Builders' Exchange in several states of the United States. He also emphasized the advantages to be derived by the members from their Exchange.

Mr. Dennis and Mr. Wright, of London, also gave some good advice on Exchange work, after which the meeting adjourned until 8 p.m.

During the evening session, Mr. Dennis, of London, presented a paper on "Technical Education," which is given in full elsewhere in this issue. It was moved by Mr. Elgie and seconded by Mr. Fielder, that a hearty vote of thanks be tendered to Mr. Dennis for the very valuable paper he had prepared for this convention. This was enthusiastically carried.

Wednesday's Session

The secretary presented his report of the directors' meeting held in Toronto on September 3, 1918.

Mr. Tobin Speaks Regarding Workmen's Compensation Act

"The subject I will speak on is one in which every man here is vitally interested. For the benefit of those who are not as familiar as might be with the regulations of the board, I might point out to you that a section of the Workmen's Compensation Act provides for the organization of any body interested in the prevention of accidents. When such a body represents a majority of an association and is approved by the Workmen's Compensation Board, it becomes a legally recognized organization. Thorough inspections are thus provided for and a record of these inspections are filed and registered.

"The loss of labor turnover on account of accidents is very large, Ontario paying \$3,500,000, and there is a further large uncalculated loss to the employers in replacing men who are injured. Loss of time is unavoidable in replacing men who have met with accidents and when these men are replaced it very often takes some time before they become as efficient as those whom it was necessary to replace. Breaking in new men always means a loss of time, not only for the man but for the foreman or superintendent who has to instruct him in his duties.

"This matter came up some time ago and at the request of your secretary, I studied the situation. My conclusion is that if this association is to become effective, a strong effort must be made to secure a sufficient membership to carry weight.

"The work of the various organizations interested in the prevention of accidents is handled in one office.

The Industrial Accident Preventative Association have a competent staff of inspectors, as well as organized accident prevention councils all over the country.

"All the numerous protective appliances, such as guards, etc., will prevent only about 30 per cent. of the accidents. The majority of accidents occur through falling material, stumbling over material, and so on, not through contact with moving machines. An educational campaign could be made the means of preventing 90 per cent. of the accidents in Canada.

"To illustrate my meaning, when I refer to the effect of education on the mind of the workman, I might cite an instance of a foreigner coming to an employer for work, who could not speak or understand English. An interpreter was called and the man started to work. His job required him to carry manufactured material to the elevator, then up to another floor, coming down with the empty trays. After making two or three trips, he was approaching the elevator for the down trip with a pile of empty trays. He could, with difficulty, see over the load he was carrying, and not seeing that the elevator was moving, he attempted to board it. Fortunately another workman was close at hand and rescued him in time. The educational system had been adopted in this plant, and its effect was such on the minds of the employees that they went to the superintendent and demanded that the new man be dismissed. They refused to work with him as they would never feel safe. It has been proved time and again that men who appreciate the causes leading up to accidents will not work with a man who does an unsafe thing.

"My advice to you is: Lay down safe rules wherever possible. Reduction of accidents means reduction in assessment and is most decidedly a money-making investment."

Considerable discussion took place on the question of the merit rating system. Mr. Elgie wanted information as to whether there was any record kept, for the protection of the employer, of men who were continually meeting with accidents. He also enquired if the question of eyesight test had ever been considered.

This opened up a serious question in the opinion of Mr. Tobin. He said it would require a lot of careful study as it would more or less penalize defective men. Something of the sort, however, should be required as a protection to the employer. Continuing, Mr. Tobin said the International Harvester Company saved \$200,000 a year by an educational system which reduced mechanical hazards in their plant. More men are killed by accident in one year in the United States than the Canadian Corps lost in the whole war. To give an idea of the number, Mr. Tobin said that these men, if buried in one grave would require a grave eight miles long.

Mr. Tobin also explained that except for death or permanent disability, men are not entitled to claim if they disobey employers' rules applying to safety regulations.

A vote of thanks was tendered to Mr. Tobin on a motion by Mr. Till, of Toronto, which was seconded by Mr. Gibbons, of London.

Mr. Gander, of Toronto, criticized the government for permitting the exorbitant wage paid for unskilled or poor mechanics during the period of the war. These men now demanded and expected to still receive this high rate.

Mr. Gander here presented a report on the Work-

men's Compensation Act, labor making the following demands: (1) That the present rate of 55 per cent. of the workmen's former wages was inadequate to meet the liabilities; (2) That the entire cost of all accidents should be borne by the various industries covered by this Act, and that injured workmen should receive compensation to the full extent of their former wages; (3) As a lot of time is lost owing to weather conditions, the men should be compensated on the basis of union or the prevailing rate of wages paid in the cities or towns; (4) That the medical provision of the Act, which at present only covers the first month of disability should cover the whole period; (5) That the scope of the Act should be broadened to include private companies not engaged in the building trade; (6) That widows should receive at least \$30 a month for themselves and \$10 for each child under 16 instead of \$20 a month and \$5 for each child up to maximum of \$40 at present.

Mr. Dancy asked for information as to medical help provided under the Workmen's Compensation Act. Mr. Gander stated that he believed this time was one month.

Mr. B. Blondie, of Chatham, said he had no desire or intention to work to the disadvantage of the workmen, but men were ready to take advantage of the employer.

Mr. Dancy cited an instance of a workman slightly scratched while handling stone. The man reported to a doctor and returned to the job with his hand bandaged and refused to work. He said he would be off for a week. Mr. Dancy reported to the board that the man should not receive undue consideration, but in spite of this the man was awarded \$20 compensation.

Mr. Elgie moved the adoption of the report of the committee, seconded by Mr. Boss. It was carried unanimously.

Mr. Elgie next read his memorial, which was presented to the government during the conference of building and construction interests held in Ottawa last November, which appeared in the issue of the "Contract Record" of December 4th, 1918.

Mr. Gander spoke very strongly in favor of the memorial and urged that it be accepted at this convention. Mr. Fielder seconded the motion and it was carried without a dissenting vote.

Mr. Elgie read the report of the committee on resolutions, which was placed on the table and discussed, clause by clause. The following is a list of these resolutions, passed by the delegates in session:

"That we place ourselves on record to assist our returned soldiers, (brothers, sons, and husbands) back into industrial life and give them work in preference to those of ourselves who were unable to go to fight."

"That there be compulsory National Technical education of the boy up to the age of 16 or 18 years, and that we bring about a reform in the apprenticeship system of various trades to produce better artisans."

"That this convention appoint a strong, energetic, organization committee to get the towns and cities of the province to connect up with the Provincial Exchange so that we can strengthen the organization. Let the slogan be 'Honesty, and to be honestly recompensed.'"

"That we associate ourselves with the Association of the Canadian Building and Construction Industries recently formed at Ottawa by the contractors of Can-

ada from coast to coast if a special investigating committee to be appointed so recommends."

"That we adopt a better system of dues or fees on the percentage, so that every man shall pay according to the business that he accomplishes each year, so that the large and small contractor may be interested in the Exchange."

"That we get into closer relations with the supply men with the object of obtaining a trade preference or discount."

"Resolved that in view of the tremendous importance at the present time of vocational guiding and vocational training, both to the youth of the province and to our industries, and also recognizing the necessity of industrial education in the re-establishment of our returned soldiers in independent civil life, the members of this convention place themselves on record as follows:

(1) That we recommend to the members of our various Builders' Exchanges that a special committee in exchange be formed to co-operate with the local vocational and technical schools in enlarging and extending their usefulness, and that we urge all employees to take an interest in the boys and young men in their employ, advising them to take suitable technical school courses.

(2) We believe that what is known as the "part time system," whereby the vocational school and the employer work in conjunction in the practical and technical training of the employee, should be adopted without delay, in all centres where adequate facilities exist.

(3) We believe in a general re-establishment of the apprentice system on a basis suited to the present day conditions and with a real regard for the interest and permanent welfare of the apprentice, the employer to receive the continuous co-operation of the school during the term of apprenticeship.

(4) In our opinion the Provincial Government should amend its regulations respecting the grants for teachers' salaries in technical and industrial schools paying our half of all salaries for day and night classes without restriction as to total amount of salary in any one institution.

(5) That the long considered grant in aid of Technical education by the Dominion Government should be provided without further delay in the general interest of our national industries.

(6) That we are strongly of the opinion that a Canadian national policy of education be instituted under Dominion Government jurisdiction, providing uniform tests, examinations and standard text books for all provinces.

(7) That a committee be named by the President to deal with the interests of the association re vocational training and apprenticeship.

Mr. Dennis, of London, next read the report of the committee on nominations, which was placed on the table for consideration.

Mr. Wright, secretary of the Provincial Association, at this point read a very cordial letter from the secretary of the Toronto Builders' Exchange, inviting the Provincial Association to hold its next annual meeting in Toronto, and promising them a royal time.

Mr. Dennis moved the adoption of the report of the nominating committee. Mr. Norton seconded the motion, which was carried.

In the afternoon the delegates were entertained to a motor trip around the city, during which many of

the industrial plants were inspected, including the Gray-Dort automobile plant, the Wm. Gray & Son Company's immense carriage factory and the new and most interesting plant of the Dominion Sugar Co., Ltd. In the latter plant, the visitors were amazed at the sight of 8,000,000 pounds of granulated sugar in the warehouse.

Technical Education Discussed

The evening meeting was called to order at 7.30 p.m., and Mr. Dillon, of Toronto, addressed the meeting on the question of the apprentice system and the necessity for technical and vocational education.

Mr. L. C. Reynolds, of the "Contract Record," also spoke at some length, on the subject of technical education. He dwelt on the necessity of some system of compulsory education for the apprentice and pointed out the importance of carrying on this work in conjunction with practical training. He also recommended that this work should be under the direction of instructors well qualified by experience in the trade or industry as well as by scientific education.

Mr. Elgie recommended the launching of a "Safety First" campaign.

Mr. Wright moved that a committee from this association appeal to the Compensation Board, or, if necessary, to the government, to ask that the clause regarding merit rating, as far as the building industry is concerned, be repealed. This motion was seconded by Mr. Elgie and carried unanimously.

Mr. R. M. Norton, of the Sarnia Bridge Co., presented a most interesting and greatly appreciated paper on the relation of steel to industry for war and during the period of reconstruction in Canada, which is given in full elsewhere in this issue.

The meeting adjourned at 10 p.m. to attend a banquet given by the Chatham Builders' Exchange in honor of the visiting delegates.

Delegates Banqueted

After everyone had done full justice to the most sumptuous repast, during which a musical programme was furnished by an excellent orchestra, Dr. Merchant, of Toronto, addressed the gathering on "Technical Education."

Dr. Merchant's Address on Technical Education

"There is a crying need for technically trained men in every trade and industry," declared Dr. Merchant, Director of Technical Education. "We must have co-operation between the technical school and the workshop. We must develop specialized talent. That is the principal object of technical school training. The solution of successful industrial education, I am firmly convinced, must come through the technical school and the workshop. I believe that a youth should attend school until he is sixteen years of age. A large proportion are led into industrial life by mere adventure into money making propositions."

Dr. Merchant's address dealt with technical education in many phases and was of great value to the representatives of the Builders' Exchanges present at the banquet.

"Education is a state need," he said. "It is not a charity, or debt, but a necessity."

"The progress of our nation depends on education. It will help to make democracy safe."

"We must develop our national resources. This calls for technical education."

"What is the fundamental problem in the conservation of our national resources? The speaker answered this question by showing that years ago, when oil was discovered, thousands of gallons of gasoline and other constituents were wasted through ignorance.

"Conservation means prevention of waste," he said. "The utilization of discovered properties. The chief cause in waste is the failure to develop. Development means that there must be education. We must begin to eliminate the waste in knowledge by developing the abilities of our children."

"I wish I could call to your mind the richness of the resources of a child's endowment. We have unlimited storehouses of resources, which must be developed. We have mineral areas, forests, fisheries, and on the other hand there is the human side with infinite possibilities."

"These resources are not realized. The efficiency of the child depends on the resources in the child which you and I must develop. They must become skilled in trades. There must be skill in craftsmanship."

"Development depends upon skill, intelligence and insight and the extent of operations is limited by our limitations in this respect. It is noticeable in every sphere of activity."

Boys Back to the School

"We don't want more men back to the land, but more boys back to the school to improve the agricultural industry."

"There is a lack of technically trained men for various trades and callings. Concerns will bear me out in this. It is particularly noticeable in your own building and contracting business. You men here want skilled men. We must conserve and develop our people. We must develop specialized talent. Some are fitted for commerce, some have aptitudes for farming, or professions. Everywhere we find 'square pegs in round holes.' The fundamental problem of technical education is guidance, in order that the boys can become skilled in vocations to which they are fitted."

"The crying demand of the age is for skill. But besides skill we must have knowledge."

"Years ago a boy used to choose between a trade or an education. A skilled man to-day must be educated. Our boys must be trained in intelligent reasons for operations. They must appreciate values and be trained in scientific conceptions fundamental to industry. They must be developed in initiative and confidence."

"There are two requisites of knowledge. One is to know the reason for a thing, and the other is to be able to see its application. These two phases mean education."

Men Machines

"Commercial men tell me their clerks are in some cases men machines. Teachers in some cases lack initiative. They become mere talking machines. The wastage of endeavor through the lack of ability to develop in unusual lines, is a hindrance to prosperity. If there is to be success in the reconstruction era it will come solely through initiative."

Dr. Merchant said that the degradation of the German people had been traced by some to an inefficient system of industrial training.

"It is not German efficiency that was wrong, but the German motive."

"Their training was reflected in their schemes for world power."

Dr. Merchant said that the solution of industrial

education must come through the school and the shop. "These must work hand in hand," he urged. "A good many depend on the school for the training of the youth. I believe that a youth should attend school until he is sixteen years of age.

"A large proportion are led into industrial life by a mere adventure into money making propositions, and the appeal to adult relationship. There must be co-operation between schools and the workshop.

"There are trades which demand scientific knowledge. The school is the place to secure this, with practical experience in the shop the result will be an efficient artisan.

"The law provides that such training can be introduced in any municipality. A boy can be kept at school part time up to 17 years of age, and serve the rest of his time in the shop.

"No person in this province is allowed to teach at vocational training unless he has had a practical training. You can establish a practical day or evening school to teach vocational training. We specify for fifty per cent. of academic training. We believe that our children going into the industries must have a broad and extensive knowledge of the world."

In conclusion Dr. Merchant said it was the wish of the Department that institutions like the Builders' Exchange give advice on educational problems. The department was willing at all times to consider suggestions.

Thursday's Session

The meeting opened on Thursday morning for the last day of the convention.

Mr. Norton, of Sarnia, moved that this association place itself on record as being in favor of assisting our returned soldiers back into industrial life in preference to those who were unable to go to fight.

Mr. Gibbons, of London, seconded this motion, which was carried.

Moved by Mr. Norton, seconded by Mr. Gibbs, of Sarnia, that the president appoint a committee of two to investigate the organization of the Association of Canadian Building & Construction Industries, and if, in their judgment, together with that of the incoming president and secretary, they consider affiliation with the Dominion organization wise, they shall empower the president to call a meeting of the board of directors to consider the question. The motion was carried.

Moved by Mr. Elgie and seconded by Mr. Till, that some better method of collecting dues be adopted. Motion carried.

Moved by Mr. Gibbs and seconded by Mr. Till, that each Exchange bring in a report at the next convention on the conditions respecting the best method of securing a trade discount. Motion carried.

Moved by Mr. Dancy, and seconded by Mr. Elgie, that each Exchange pay a per capita tax of \$1.00 as their roll stands at the annual meeting prior to the annual meeting of the Provincial Builders' and Supply Association of Ontario, at which meeting this assessment is due and payable. Motion carried.

Moved by Mr. Grace, of Sarnia, and seconded by Mr. Dillon, that each local builders' exchange urge the municipality to take up the offer of the government as a solution of the industrial housing question. Motion carried.

Moved by Mr. Couse, and seconded by Mr. Gibbs,

that the question of organization be left in the hands of the executive. Motion carried.

Moved by Mr. Geo. Gander, seconded by Mr. Gibbs, that the sum of \$75 be paid as an honorarium to the secretary for his services during the past year. Motion carried.

Moved by Mr. Dillon, and seconded by Mr. Dancy, that the executive call a meeting of the members of the local exchanges to be called by the president to consider the question of affiliation with the Dominion association. Carried.

Moved by Mr. Tomlinson, and seconded by Mr. Dillon, that the Provincial Association request the Compensation Board to grant permission to affiliate with the Accident Preventative Association and that the secretary notify the Accident Preventative Association of this request. Carried.

Moved by Mr. Gander, and seconded by Mr. Blondie, that the President be empowered to call any member to assist in organization work. Carried.

Moved by Mr. Dillon, and seconded by Mr. Dancy, that a vote of thanks be given to the "Contract Record" for the able services rendered to the association and for their assistance in making this convention a success. Motion carried unanimously. Mr. Dillon, Mr. Dancy and Mr. Wright all spoke on this motion and called attention to the valuable services rendered by this journal in the organization work of the Dominion association, as well as the provincial and local exchanges.

Mr. Reynolds expressed a sincere feeling of gratification for the hearty vote of thanks and laudatory expressions of good will.

The following officers were elected for 1919: President, Herbert Elgie, Toronto; first vice-president, Lieut.-Col. J. L. Youngs, V.C., of Stratford; second vice-president, John Hildrith, Chatham; secretary-treasurer, T. R. Wright, London. The delegates are: Chatham, Mr. Palmer; London, L. A. Boss; Sarnia, R. M. Norton; Galt, Mr. Thomas; Hamilton, Mr. Murry; St. Catharines, Mr. Nicholson; Ottawa, Geo. A. Crain; Toronto, W. E. Dillon and C. F. Till.

The register at the convention was as follows: London—T. R. Wright, L. A. Boss, A. E. Gibbons, E. R. Dennis, H. Hayman; Toronto—C. F. Till, R. H. Falkiner, H. Elgie, Geo. Gander, L. C. Reynolds, A. H. Dancy, F. M. Tobin, W. E. Dillon, Fred W. Shield, British Trade Commissioner; Stratford—Robert Marson; Sarnia—R. W. Norton, T. Grace, H. A. Couse, N. E. Gibb, R. Simpson; Chatham—F. C. Philips, G. R. Guy, Thos. Raymond, Geo. Fielder, J. J. Killer, J. H. Glassco, B. Blondie, W. H. Palmer, C. R. Bowers, Albert Tomlinson, Frank Bland, Capt. H. E. Crow, John W. Draper, Frank Sparks, E. Raymond, A. M. Burtch, B. Miller Echlin, Ross Huff.

Union bricklayers and hoisting engineers in 112 cities of the United States were ordered to strike on Feb. 10 in sympathy with the striking members of the Carpenters' Union. The number of men affected is between 300,000 and 400,000.

Organized labor, as represented by the Trades and Labor Council in Quebec, is dissatisfied with the provisions of the Workmen's Compensation Act on the statute books of the Province, and a strong delegation representing the council recently came before the Government, making a strong plea for radical changes in the Act.

Is Technical Education in Ontario Doomed to Failure?

By E. R. Dennis*

Men, for a long time, stood in wonder and awe of words. In religion, in politics, in science, in medicine, great and imposing words have been solemnly and threateningly held before us to frighten us at times from our inclination toward original thought and action.

But of late we are more and more inclined to examine these words and phrases—to enquire what they mean—whether they mean anything—whether back of their pretension is anything really worth while.

Problem of Filling the Ranks of the Mechanics

During recent years "Technical Education" has been a very popular phrase. We have welcomed it like a boy does a new toy. We have come to regard it as a panacea for educational, social and industrial ills. We fear the stigma of being classed as reactionary and unprogressive if we fail to glow with enthusiasm when the magic words are pronounced. We listen to reports on technical education at our gatherings of manufacturers and business men, pass resolutions, and depart imagining that some day, somehow, technical education will perform a miracle in relieving and perhaps remedying the crisis that our industries face, and have been facing for some time, with respect to securing skilled, trained and competent mechanics—who will be worthy to fill the places of the older men, who will ere long have to retire from active work, and men who acquired their skill and value as craftsmen under the apprenticeship system of a generation ago.

In order that I may not be considered too presumptuous in offering some criticisms and suggestions in connection with this subject, you will, I trust, pardon a brief reference to some of my personal experiences.

Some seven or eight years ago we realized in our own industry that a serious situation was developing in regard to obtaining skilled workmen required for the growing needs of a growing business manufacturing a product that required mechanics of high order to turn out.

We realized then, as you have realized, that our real mechanics who could turn out first class work were the older men, who have thoroughly learned their trade in years gone by as apprentices under the old and very efficient system.

We found that the boys coming out of our public schools did not take to the idea of learning a trade—that boys in our high schools and collegiate institutes were being educated absolutely away from any idea of entering the industries.

Modern shop organization and the attitude of the parents and the boys and the schools seem to make the old system of apprenticeship an impossibility.

Boys were entering shops with the central idea of getting every dollar in wages they could immediately demand, with no consideration for their future usefulness and future earning power, and the consequence was shops were bringing up machine hands, handy men—but not good old-fashioned, thoroughly trained mechanics.

We then organized in our factory in 1911, a modest night school for those of our employees who would

take advantage of it. From 15 to 20 of them did. Our draftsmen showed them how to read blue prints, to understand shop drawings, gave instruction in shop mathematics, laying out, studied with them and helped them with their daily problems. We read papers on such subjects as the processes of steel manufacture, architecture, stair building. We also gave them elemental drawing and some rough engineering, and tried to make everything as practical and simplified as possible. The results were gratifying, both from the standpoint of helping the young men to be better and more skilled workmen, and improving the morale of the shops.

Then a movement was developing in the province aiming to provide practical education for industrial workers.

In 1911 (I think it was) the Ontario Industrial Education Act was passed, and I am bound to say it was the most important and far-reaching piece of educational legislation placed on the statute books since the days of Egerton Ryerson—it was supported by both parties and all newspapers.

At this time, the Builders' Exchange of London, took a hand in the movement, and it stands to the credit of our Builders' Exchange that it took the initiative, and through its action and representations, our Board of Education decided to establish an industrial school under the new Industrial Educational Act. A committee from our Exchange visited various centres where industrial and technical education was in operation and went as a deputation to our School Board—presenting their report and recommendations—which were accepted and acted upon.

The Advent of the Technical School

Well, we gave up our modest little night school held in the drafting room of our factory. We would not find it necessary, we said, as we would have a real industrial and art school in our city. Since that time I was for four years a member of the Board of Education in London, and have had the honor of being Chairman of the Board, and Chairman of the Technical School Committee, and Chairman of the Collegiate Institute Board. For seven years in London we have worked hard to establish a sound, practical and modern system of vocational education. There were many obstacles, difficulties and disappointments to overcome. But last month, the Minister of Education formally opened our new Technical School. Physically it is the second largest in the province, and I believe it is the best practical institution of its kind in Ontario.

As I have intimated, 7 years ago we discontinued our night school in connection with our factory, and gave our energies to assisting in establishing industrial education on a wider basis in the city.

Seven years ago we found numbers of men and youths constantly looking for employment, and they could not obtain it. When asked what they could do, they would say "anything." But in reality they could not do anything, and consequently we had the anomaly of hundreds of men, on the one hand, looking for

*Of Dennis Wire & Iron Goods Co., London

work and could not get it, and on the other hand, we had employers and industries everywhere seeking earnestly for men and could not employ those applying because they could not deliver the goods.

And we have the Industrial Education Act in force seven, or maybe eight years, and as far as I can learn our manufacturers and building industries are in as an unfortunate position to-day as regards skilled mechanics as they were seven years ago.

In the event of a pronounced building revival taking place this spring, and you contractors should be called upon to erect numerous buildings of the better and finer type, you know that one of your chief bugbears is going to be to get men who are any good, as real honest-to-goodness mechanics.

What Results Has Ontario to Show in Technical Education?

And this being true, can industrial and technical education be said to be a success in Ontario during the past seven years. Where are the fruits?

Our cost of production at the present time is very high. This is not so much on account of the rate of wages we are paying, but because we are paying high wages to men who are not worth it—because they are untrained, unskilled and with no enthusiasm or desire to become real mechanics.

During the past ten years our industries and our labor organizations have been busy with many reforms. Better advertising and selling methods have been instituted; cost accounting has been brought to a science. Welfare work has been introduced in large establishments. Shorter hours have been agitated. Compensation for injuries to workmen has been provided. Employer and employee have been on the lookout for their rights and grievances—and very properly so—but in one great all-important thing they have not kept pace with the progress in other matters; and that is—next to nothing has been done to train up our boys leaving school to become skilled craftsmen. As the Russian proverb says of poverty: That is not a disgrace—it is a crime.

Our federal and provincial governments are urging Canadian manufacturers to seek foreign markets. Our government is spending large sums in its effort to encourage our manufacturers to engage in export business. How in the name of common sense is this country going to manufacture and export articles in competition with the world if we don't give more thought to the problem of educating our Canadian youth to become skilled craftsmen, designers and artists.

It is said that no country in the world is so neglectful, so far behind in the matter of mechanical training of its youth as Canada. Is it not true? Look around you and tell me what we as employers are doing in a patriotic way and in the interest of Canadian industry, to train up self-reliant, skilled artisans—better trained, more thorough, more capable of turning out a workmanlike job than mechanics who have learned their trade in the Old Land.

Boys Move from Shop to Shop

What is the trouble? Where must we place the blame? You will say, as I have often said, it is next to impossible to get boys who are willing to make the apparent sacrifice necessary to thoroughly learn a trade. They will come and stay in a shop for a few

months, pick up a little, and then hie away somewhere else in an effort to get more money.

Well, sir, the blame is not with the boy. We have in Canada, and particularly in Ontario, the brightest, most intelligent and finest type of boy to be found anywhere in the world. If we had the right methods, if we had sufficient will and imagination to take hold of the problem, with the splendid human material we have here, we could, in a short time, have the most skilled artisans, wood carvers, painters, artists, sculptors, etc., for industrial purposes, in the world, and we could out-distance any country in the world in many lines of manufacture, because of the superior skill and intelligence of our mechanics, coupled with our wealth of materials.

The parents, the schools, and the employers, are not giving the boys of Ontario a square deal, and if we don't soon wake up to this fact and mend our ways, the result will be disastrous to our status as an industrial people in competition with other countries.

I believe that a proper, fruitful system of giving real, practical, mechanical training to our boys is more important to our industries than the tariff—and at that I'm a strong believer in protection—and Canada for the Canadians.

Is the government then to blame for our failure? It seems to be the fashion now-a-days to blame everything on the government that doesn't suit us. The government doubtless has enough to answer for without being blamed for something it is not responsible for.

The attitude of, and the encouragement given by, the provincial government to technical education is quite generous, and the government's educational policy as regards technical education at least is broad-minded and satisfactory.

Provisions of Ontario Education Act

You are doubtless familiar with the method of organizing an industrial or technical and art school, under the Ontario Education Act. An industrial advisory committee is formed to govern the work of the school, and this industrial committee is composed of six members of the Board of Education, three employers of labor, and three employees. By this means the personnel of the committee should embrace "all the talents."

After the school is organized the government makes certain basic grants; they pay for all the machinery and equipment installed up to a maximum amount of \$3,000 per annum, and they pay fifty per cent. of all salaries for both day and night classes, up to a maximum salary list of \$10,000 per year. The courses of training provided for are excellent, practical and comprehensive.

The chief director and inspector of technical education is a man well known all over the continent for his scholarship, executive ability, interest in the work, and broadness of view. He also realizes that the work of the technical school must be carried on for the primary purpose of supplying our industries with trained workers.

In London we have a technical and art school building that is ideal for the purpose. It is well managed by a most efficient principal. It has a staff of teachers who are first class in their respective departments, and men who have had sound practical experi-

ence in the industries. The equipment is modern and of the best.

The night school enrollment is between 500 and 600; the day class attendance is 102 boys and girls.

Worse Off For Mechanics Now Than For Years Past

Giving credit for all this we are still faced with the stubborn fact that we are worse off to-day for skilled workers than we have been for many years past.

A very great number of our best, most active young men have gone overseas. Our boys and young men have been getting some experience in running machinery, but they have not been learning real trades.

There are thousands of returned men who must have employment, but who need training.

There is inevitably coming in Ontario an industrial and a building revival—whether it will arrive in three months, six months or twelve months, we do not know—but it will come.

If our system of technical education does not guide the boys into practical vocations, train them to become expert mechanics and direct them into our industries, then it is a failure.

And it is destined to failure if we are not alive to our responsibilities in the matter—when I say “we” I mean you and me. I mean the parents and the employers of this province.

Many people talk as though technical education were a recent discovery! They had better technical education fifty or a hundred years ago than we have to-day.

In those old days they had the apprentice system, and when the boy in England was apprenticed to a thorough going master mechanic for five years or seven years, and had to stick it out, and “learn the trade” under practical shop conditions, he got real technical education, and under that system of indentured apprenticeship the industries of Great Britain thrived. Her manufactured products and her craftsmen in the building trades were recognized as the best in the world.

Eight or nine years ago, when we were agitating for technical education, we said the old apprenticeship system was a thing of the past, and we spoke the truth.

We also said that modern industrial conditions and organization were such that we could never again have a system of apprenticeship in which boys were bound to the employer to learn their trade.

We said that if we would establish industrial schools, technical and art schools, they would take the place of the apprentice system of by-gone days.

And in both these statements, I, along with others, was dead wrong.

What we need in Ontario at the present time is a leader who doesn't know that the thing can't be done—and will go ahead and do it.

Re-establish the Apprenticeship System

What we want, and what we ought to have, and what we are going to have, is a re-establishment of the apprenticeship system in our building trades, in our shops, and in our various industries.

But, don't forget this, it must be a modern system; a more enlightened system than the old.

It must be a system in which the employer does not, or cannot, exploit the boy.

This new apprentice system will not do away with the technical schools we have recently established.

On the contrary, it will require more and larger technical schools. It will require more liberal govern-

ment grants. It will require that these schools be attended by a far greater proportion of our brightest boys than is at present contemplated.

It will require as teachers in these schools practical men who can do things in a skilful way with their hands and are also educated men as teachers.

What then is the basis and the method for inaugurating this modern apprenticeship? Well, we must begin at the beginning and put first things first. We must begin by educating the parents and the public school teachers.

Believe me, both need education very badly along certain lines.

Our public school teachers must realize that they are citizens as well as pedagogues. They must be encouraged and not discouraged to take part in public affairs. They should visit our factories, our offices, our wholesale houses, buildings in course of construction and decoration, and acquaint themselves fully—not superficially—with living, working conditions, under which ninety per cent. of their boys must spend the best and most active part of their lives in making their way on this old earth.

I see our friend, Tom Moore, President of the Dominion Trades and Labor Council, is inviting the school teachers to join the unions. By so doing he assures them they can secure better conditions. I had the pleasure of hearing Mr. Moore speak at Ottawa in November, and he impressed us as a fair-minded, intelligent and capable leader, but I would like to ask if there is not a danger in some quarters of carrying the policy of “getting all you can and giving as little as you can,” too far?

Should we not be reminded sometimes that we can get more by being worth more. Our young men are being educated in the doctrine of reducing the week's working hours to the irreducible minimum. In these days is there not a place for the literature that our fathers read and which describes the apprentice boy who got down to work an hour earlier than his associates to put the shop in order and worked a little later after the others had gone to study (and improve his skill) and as a result of his absorbing interest in his work and his industry he finally became the owner of the plant.

I realize that workers have their rights and grievances that should be adjusted, but are not the masses becoming too much imbued with the idea that they should put in as few hours as possible at their chosen calling and spend the money earned and the balance of their time in other and unrelated pursuits. Such methods will not develop great artists, sculptors or the master craftsmen such as have made the older countries famous in the past. Such methods will not develop a Michael Angelo or a Thomas A. Edison.

Boy Should be Bound for a Definite Period

We are told that for some reason or other more or less obscure every man should have a hobby. Why should not his hobby be his trade, his calling or his business, but with his ideas liberalized and broadened so that his devotion to it would not be a drudgery but a pleasure and a means of growth? But to return to our modern apprentice system; if we are going to have satisfactory results or anything nearly satisfactory, the boy on leaving school and entering the industry should be bound for a definite period—not five years or seven years, as in the old days, but for a period of two years

or three years, depending on the nature of the business he intends to learn.

He will go into the industry from the technical or industrial school, where he will have learned the fundamental principles of the trade he is taking up and where he will have gained a certain amount of manual dexterity in handling tools and appliances. The teacher, the parent and the employer will get together in the interest of the boy and arrange to guide him into a vocation for which he has a liking and an aptitude, in which he will not be a square peg in a round hole, and during the period of his apprenticeship the parent, teacher and employer will together co-operate in the training and development of the apprentice.

The proper arrangement would be to have a properly equipped technical school in connection with every industrial plant, where the apprentice can continue his technical training along with his practical work in the shop. This, however, is not in the present day feasible, and in any case would lead to a lot of overlapping of effort.

Under his two years or three years apprenticeship the boy will work on the part time system; his employer will be obliged to give him two half days off a week, but on those two half days he will be under control and discipline and on his part will be obliged to attend his local technical school to continue his education in drafting, mathematics, commercial chemistry, etc., and he will be helped at the school to solve the technical side of practical problems which he is encountering from day to day in his work in the factory or in his trade.

Part-Time System of Apprenticeship

In order to bring about such a part time system of apprenticeship, real and enthusiastic co-operation on the part of employers and parents will be absolutely necessary. I have no doubt you will find the schools ready to co-operate, but at any rate we must recognize that the schools belong to and are being paid for by the people, and we must see that they do co-operate.

In our modernly organized industries we have men in charge of accounting, selling, advertising, engineering, welfare work, and so on, and we will, in the near future, have a man in charge of the department looking after the training and development of the employees, and it will be his duty to see that the factory and the school are co-operating in the development and training of the apprentice.

In the city of London we have, as I have intimated, approximately one hundred pupils in our new technical school. In our Collegiate Institute we have approximately nine hundred pupils. It will be the logical and common-sense thing for this proportion to be reversed—ten or fifteen per cent. taking the academic classical work that will prepare them to be professional people, and the eighty or ninety per cent. pursuing studies in technical and art school fitting them for the work in life that eighty-five or ninety per cent. of the population pursue.

Every Builders' Exchange in every town or city will have its technical education committee as the most important it possesses, and it will be the duty of this committee to work with the technical school and the employers in making successful and satisfactory modern apprenticeship, the basis of the bond and agreement of which will be a golden rule agreement with as much care and thought being given to the

welfare and development of the apprentice as to the interest of the industry.

Some people have an idea that we can turn mechanics out of trade schools full fledged and ready to work as journeymen. This is a fallacy. Mechanics who graduate from a school may learn to do a piece of work so that it will pass muster, but put them on a building job or in a factory and the unreasonable time it would take them to do that piece of work would make them altogether unprofitable and out of the question as a practical factor in the business.

Mechanic Must Finish Training in the Shop

The journeyman mechanic must finish his training in the shop, in the factory, in the industry itself under regular business and shop conditions, the school previously giving him the right sort of education and grasp of the fundamentals. It is no use trying to tack a little manual training on to our modern Collegiate Institute and call it a Technical School because the atmosphere of the Collegiate Institute and the attitude of the teachers has a tendency to direct the pupils altogether away from industrial life.

What we want is real technical and industrial schools that will not merely turn out a few commercial chemists, engineers and factory managers, but that will give the great mass of the students a real technical education that will fit them to go into the shops, factories and building trades in the land and by their skilled service be of real use to themselves, to the industry and to the country.

Nationalized Education

It is high time now that the Dominion Government made its long considered financial grant to technical education. Education is a matter coming under the jurisdiction of the provinces. Why then should the Dominion Government be called on for a subsidy? Simply because technical education is vital to the welfare of the industries of the nation. Dominion Governments for the last twenty-five or thirty years have been greatly interested in encouraging and developing industry by means of tariff legislation, bonuses, subsidizing and appointing trades agents in foreign countries and by many other means, but one of the greatest aids that the Dominion Government can give to industry will be to subsidize and strengthen our system of technical and art schools throughout the Dominion, so that eventually we will have the most intelligent and best trained workers in Canada there are in any country of its size in the world, and I believe further that education in Canada should be nationalized, that we should not have such a patch-work system of education in Canada as we have at the present time—each province having its own peculiar policy and educational standards.

Why should not the Dominion Government have a Canadian national policy in education with the various provinces carrying out that policy adapted to the needs of the varied provinces? Why should it be that a young man or woman graduating from a normal school in Ontario is not qualified to teach in Manitoba or New Brunswick? If a man with a large family moves to Saskatchewan from Ontario, why is it that the text books which they take with them are not authorized or of any use to them? Why should there be different standards, tests and text books in all the different provinces? Does it make for unity, does it make for national Canadian spirit? Is it not time that we attached less importance to the fact that we

are Scotch, Irish or English by birth or descent and realized that if this country is going to measure up to its opportunities every man, woman and child in it must be Canadian?

If we have a national system of education will it not be easier to teach Canadian ideals and Canadian patriotism so that every child in every province in the Dominion will receive the same national stimulus and inspiration.

In conclusion I wish to say that eventually our technical and art schools are going to become the real

force in the various communities in which they exist. Whether we will get in our industrial life the full possible benefit from them now and during the next few years or whether it will take fifteen or twenty years to obtain for our boys and for the nation the tremendous benefit that technical education can provide depend altogether upon whether practical two-fisted men like yourselves make this business your own business and organize and co-operate in the way I have intimated in linking up the school with the shop and factory and with your own particular business.

Steel in War Work and Reconstruction

The Relation of Steel to General Construction During the War and What to Expect During Reconstruction

By Mr. R. W. Norton*

THE relation of steel to the war is a subject that is a great deal broader than the writer would undertake to handle at this time. Nevertheless, we cannot separate that relation in enumerating its effect on the construction work in the country, and its direct effect on the various members of the provincial builders' exchanges.

You will pardon me for taking up the history of steel at the beginning of the war, and carrying it down through the various times, up to the signing of the armistice on November 11th of last year.

Just previous to the war the conditions of the steel market was at the lowest ebb known in history. Structural steel was sold at some of the mills in the United States as low as 1c per pound, and delivery could be obtained from them at the purchaser's convenience. There was a surplus throughout the world. Manufacturers, contractors and others were busy fabricating and placing steel in buildings and different structures.

When the war broke out, and during the first nine months, this construction work almost entirely stopped, and the price of steel in its abundance was so low that many of the fabricators and merchants of steel went out of business. Gradually, as the war progressed the demand for shell steel, munitions, munition buildings, the requirements for war needs in America, as well as in Europe, began to draw on the capacity of the steel mills of the world. About July 1st, 1915, the demand was beginning to be felt so that prices began to raise, and from that time until September, 1917, the prices fluctuated, but were generally going up. While the rise in the price of steel was not in proportion to that of many other commodities, except in a few instances, and one of the most striking instances was at a period about July 1st, 1917, when the mill price reached a maximum. At that time we were offered steel from the American mills at 4½, 6 and 10 cents per lb. Delivery to be made at their convenience. This exorbitant price brought about government control of the price of steel in the United States, and not only price control but absolute control of its use. The United States Government fixed the mill price at 2, 9, 3 and 3¼ cents, which you will note is a great deal below the prices which were asked about July 1st.

The effect of the above price fixing has had a great

deal to do with stabilizing the industry and saving a great many firms from going into bankruptcy, also prevented and discouraged all kinds of wildcat schemes in the industry. It gave the steel manufacturers and the mills a fair remuneration, but not an exorbitant price. The steel mills of the United States entered into an agreement with the government voluntarily to supply them with steel, and also to assist in the priority control. During the latter part of 1917, and during 1918, up to the signing of the armistice, the United States Government, together with the allied governments, were taking practically 100 per cent. of the capacity of all the steel mills of Canada and the United States. The mills in the States were placed absolutely under the control of the government. In Canada they were only morally placed under the control of the Munitions Board. In the States the prices were absolutely fixed by the government, and in Canada they were only from a moral standpoint.

The demand for plate on the plate mills was so great that many of the Canadian mills received from 8c to 10c per pound for plate which in previous years they were glad to take 1½c to 1¾c, but as the plate mills of Canada only supplied a very limited quantity of plate and only in limited sizes, it did not generally affect the maximum supply.

The United States Government prohibited the export of plates from the United States, except under a license system, and the licenses to export plate could not be secured only that the plates be used for war purposes. This license system was extended during 1918 to shapes and bars. The Canadian iron merchants and fabricators were not directly under the control of the United States Government in the disposal of steel which they might have in their possession, yet we could not secure any material to replace that which we used from our stocks, except that we gave an affidavit that this material was used, or would be, for the essentials of war in connection with the allied effort. Hence the steel manufacturers, fabricators, merchants, etc., of Canada, had to confine their efforts entirely to the essentials of war.

Construction Curtailed

This condition brought about entire stoppage of all construction work, excepting for munition plants, agricultural machinery and plants for manufacturing same, or anything pertaining to food, shipbuilding and

*Of Sarnia Bridge Co.

other general war purposes. The general fabricating shops either had to go into the munition business or take such work as building a few munition plants, and other minor work that came up. Many of them went into the fabrication of ship plates, and material along this line.

During the four years of the war, the fabricating shops of Canada, and I believe many of the shops in the United States, were either idle or working to a small percentage of their capacity. The contracting industry and the building trades turned their attention and energy to supplying the needs of the war. Many trades changed their business entirely, and we have come now to a period where we will have to drop back into our old channels of work, and take up the reins where we left off four years ago.

When the armistice was signed and its conditions became known throughout the business world, we realized that the war was practically at an end. When the conditions of the armistice were carried out, Germany surrendering her fleet and our troops attending the watch on the Rhine, we knew positively that world domination by military force and oppression could not exist, and that it was only a matter of a few months when peace would be signed and we hope for all time to come. It was then the business men of Canada began to realize that we had to change from the old order of business to a new order, or peace conditions. The steel industry of North America arose to the occasion as quickly as any other organization. Plants that were equipped to turn out shell steel and other material for war purposes only, were immediately changed to handle structural steel, steel bars and material for building work, so as to be ready as soon as possible, to take up the business of re-construction, not only in this country but in Europe.

During the last four years practically no municipal or public work has been undertaken, except that which was absolutely necessary. Building for manufacturing luxuries, automobiles, and for the manufacture of many things that the people of this country have been taught to use, but which during the war were considered unnecessary, will now have to be taken up and gone ahead with. It is the general opinion of all business men that within a very few weeks the contracting industry of Canada will be as busy as it was five years ago, notwithstanding high prices of building material and labor, for, what we are apt to consider as high prices are not in reality as high as many people would lead us to believe. The price of any commodity can only be reckoned at its relative value. There is more wealth in the country at the present time than ever before. When you compare a staple article of food or, say, a bushel of wheat, with the present price of building material and labor, is the price of building material any higher comparatively, than it was four years ago. We are living under different conditions, or rather conditions where the dollar is worth only half, approximately, what it was worth four years ago. It will probably take years for the value of a dollar to re-adjust itself back to the former value it had. Until such time as this transition takes place we will continually have high prices, but only relatively:

The steel industry of North America has taken the lead in re-adjusting back to former conditions. Whether they maintain this lead or not time only will tell. With large foreign orders on their books for re-construction work in the devastated fields of Europe,

Judge Gary, of the United States Steel Corporation, advocated and carried through a reduction of four dollars per ton on the products of the United States Steel Corporation. The independent mills throughout North America had to follow the lead of the larger corporation. Whether this reduction will remain or not is very uncertain. Many of the steel people in the larger corporations believe that as soon as shipping is available, and building operations open, the prices will revert back to the government price of last year, although there is another class who believe that the price will fall considerably lower, but the general trend of opinion is that they will not fall lower until the value of the dollar begins to return to its pre-war value, and it will probably take several years for this to be accomplished.

With the above thoughts in view, and with the large amount of re-construction work which is necessary in this country, and also with the large immigration which will probably come to us within the near future, I believe that the contracting and building industry of Canada is on the verge of one of the greatest eras of prosperity which it has ever had, and it is up to us to grasp the opportunity and make the most of it by united effort and co-operation.

Trade Publications

Railway Signals—The General Railway Signal Co. have issued Booklet 1003A describing G. R. S. model 2A signal. The illustrations showing typical applications are very complete.

Condensers and Vacuum Pumps—Bulletin No. 37, by the Goldie and McCulloch Co., head office, Galt, describing rotary jet condensers and vacuum pumps; illustrated. Also Bulletin No. 36, describing single and multi-stage centrifugal pumps.

The London Concrete Machinery Co., Limited, have just issued two new catalogues. Catalogue No. 48 contains sixty pages and is entitled "London Concrete Mixers and Contractors Outfits;" it illustrates the company's full line of London concrete mixers and gasoline hoisting engines, elevators, contractors' barrows and carts. Catalogue No. 50 has 40 pages of illustrated matter describing the Novo dust proof and frost proof gasoline engine, as well as the full line of Novo pumps, air compressors and outfits.

Obituary

The death of Mr. John Pretty, one of the engineers connected with the Quebec Bridge, is reported to have occurred at Woodbury, N.J., through an accident. Mr. Pretty's home was at Saskatoon, Sask.

Mr. Melville Delos Grimshaw died recently of pneumonia, developed from influenza. Mr. Grimshaw was born in Kingston 34 years ago, and took a science course in Queen's University. Settling in Toronto ten years ago, for a time he followed the contracting business.

Mr. James Blackmore, after an illness of more than two years from cancer, died recently in the Home for Incurables in Toronto, at the age of 80 years. He was born in Cornwall, England, and came to Toronto in 1864, where he followed his trade of carpenter and builder up until the time of his illness.

Mr. Robt. Reid, owner of the Montreal Sculpture and General Marble and Granite Works, died recently at his home in Montreal. Mr. Reid, who had reached the age of 75 years, was born in Scotland and came to Canada early in life. He was one of the best-known men in the marble and granite trade in this country.

Are Bridge Engineers Losing Their Heads on Unit Stresses?

MR. J. A. L. WADDELL, consulting engineer, of Kansas City, Mo., referring, in Engineering News-Record, to the General Specifications for Steel Railway Bridges, published by the Engineering Institute of Canada, calls attention to the radical change suggested in the compression formula that appears to him to be inconsistent. He says the report of the Committee on Column Tests of the American Society of Civil Engineers appears to have caused some fright among bridge designers; for I notice that the Engineering Institute of Canada has lately published a "General Specification for Steel Railway Bridges," in which the unit stress for columns is given by the formula,

$$p = 12,000 - 0.3 (l/r)^2$$

in which l = the unsupported length of the column in inches and r = its least radius of gyration in inches.

This is quite a sudden jump from the old standard formula,

$$p = 16,000 - 60l/r$$

The change indicates one of two things: Either that hitherto we have been overstressing compression members from 15 to 25 per cent., or that there is going to be wasted a vast quantity of metal in the future.

Moreover, in making such a sweeping change in the compression formula the writers of the Canadian specifications were not consistent, because in Clause 47 they allow for the compression flanges of beams an intensity of

$$16,000 - 200l/b$$

in the case of railway stringers l/b is generally in the neighborhood of 10; hence the intensity of working stress is about 14,000 lb. As b is equal to about 4.5r, for $l/b = 10$ we shall have $l/r = 45$. Substituting this in the Canadian column formula gives

$$p = 12,000 - 0.3 (45)^2 = 11,400 \text{ lb.}$$

In the case of one compression member of a bridge, it appears to be legitimate to stress the metal up to 14,000 lb. per square inch, and in another up to only 11,400 lb. per square inch, a difference of 23 per cent. And there is no valid reason for stressing differently a strut which forms a part of the top chord of a truss and a strut which forms a part of the top flange of a beam. "Consistency, thou art a jewel!"

If the correctness of the formula for compression flanges of beams be conceded—a formula which, for a dozen years or more, has been one of the clauses of the American Railway Engineering Association's standard bridge-specifications, and which the Engineering Institute of Canada has appropriated without change—and if it be granted that b is generally equal to about 4.5r—why should not the equivalent formula,

$$p = 16,000 - 44l/r,$$

apply in general to struts with fixed ends? Be it noticed that this formula gives higher results than does my old formula,

$$p = 16,000 - 60l/r.$$

The American Railway Engineering Association is getting ready to trim down materially its old intensities for steel struts, although not to the extent that the Engineering Institute of Canada has done.

What aggravates the effect of this proposed decrease of compression intensities is that, simultaneously therewith, the American Railway Engineering Association is contemplating increasing its tensile in-

tensity of working stress from 16,000 lb. to 18,000 lb.; and other specification writers are advising that it be made as high as 20,000 lb. To an outsider it must look as if the bridge engineers of this country were losing their heads!

The compression tests that started the present wave of apprehension did not have governing conditions corresponding properly to those of actual truss-members; hence I would suggest that, before the bridge engineers of America take the drastic step of assuming steel in compression to be only 60 or 70 per cent. as strong as the same material in tension, some really practical tests of struts be made under conditions corresponding to those in actual structures. Such a series of tests would cost considerable money; but, if the Bureau of Standards at Washington were to indorse the suggestion to make them, it ought not to be at all difficult to obtain from Congress an ample appropriation for the purpose.

Method of Conducting Tests.

Let there be built a five-panel riveted-truss bridge of about 100 ft. span; let the middle panel-lengths of the top chords thereof be made decidedly weaker than all the other portions of the structure; and let a uniformly distributed live load be applied at the panel-points by hydraulic pistons. All portions of the structure, including the two weak members, should be scientifically detailed, so that failure will inevitably take place in the main portions of the weak struts and not in the details thereof, and so that the bridge can be used for a long series of tests to destruction of the said mid-panel lengths of the top chords. The weak members should be attached to the connecting plates with an ample number of rivets to develop the full strength of the test pieces; and these rivets should be removed carefully after each test to destruction is completed.

Of course, it would be entirely practicable to vary the value of l/r in the different tests, provided that the attachment of the test-strut be not made eccentric.

There should be a supporting platform beneath the span to prevent its falling any material distance when failure occurs.

By adopting a weak vertical post instead of a weak panel-length of top chord, and by loading (at the elevation of the latter) three panel-points only, a series of tests could be made on vertical posts. A similar series could be carried out on the inclined end posts.

A cheaper method than that just described, but not quite as satisfactory, would be to build a single truss, instead of the complete span, and steady it laterally but not vertically, and then to apply the test loadings directly above the top chord at the panel-points. A great advantage of the span tests as compared with the truss tests is that duplicate tests could be made simultaneously on similar members. Moreover, the span tests would be in practically exact accord with actual conditions of loading, while the truss tests would not.

By removing occasionally the test loading, the elastic limits of the struts could be ascertained through noting the absence or otherwise of permanent set.

Experiments similar to those described could be made on a pin-connected span or a pin-connected truss so as to determine the strength of struts with hinged ends.

Ontario to Spend \$25,000,000 on Construction

Premier Hearst has made the definite announcement that the Ontario Government proposes to expend approximately \$25,000,000 this year on buildings and other construction work. These projects are to be got under way at once in order to provide employment for the large number of men now idle. Preliminary work has, in some cases, already been started, and as soon as the weather opens up sufficiently the construction will go full speed ahead. It is estimated that there will be 39,477 men employed on this work during the summer, not including those employed by the T. & N. O. Commission and the Hydro-electric Commission, whose labor requirements, the Prime Minister said, would run into the thousands.

The amounts to be expended on new buildings and repairs to existing buildings in the various cities and towns throughout the province, are estimated as follows: Toronto, \$658,500; Brockville, \$76,800; Hamilton, \$70,620; Kingston, \$110,000; London, \$104,500; Mimico, \$89,600; Orillia, \$119,650; Penetang, \$17,000; Whitby, \$482,800; Woodstock, \$128,500; Ottawa, \$38,550; Normal schools at London, Hamilton, North Bay, Peterboro' and Stratford, \$20,200; Belleville, \$50,000; Brantford, \$7,750; Guelph, \$12,100; other expenditures under this classification, \$139,460. New construction and repairs in northern Ontario districts, it is estimated, will approximate \$204,670.

Five million dollars of the total is set aside for highway construction, including work on the Provincial highway and on county systems receiving assistance from the Province. The amount to be expended in connection with the housing scheme this year is also set down as approximately \$5,000,000, the total amount made available under recent legislative measures for this purpose being \$11,000,000.

In Northern Ontario the expenditure is to be about \$2,600,000, divided as follows: Roads, buildings and other construction under northern Ontario development branch, \$1,250,000; surveys, \$100,000; fire ranging, \$450,000; construction of locks, dams, bridges, roads, etc., under Public Works Department, \$300,000; colonization roads, \$500,000.

The T. & N. O. Railway, it is estimated, will spend during the season \$1,000,000 on buildings, extensions and improvements to the system. The estimates of the Hydro-electric Power Commission of Ontario have not yet been definitely decided upon, but the minimum capital expenditure suggested is \$9,000,000.

During the season work on the Queenston-Chippawa scheme will be carried out by the Hydro Commission, and it is anticipated that extension works will be carried on at Nipigon, High Falls and other points, which will increase the force working under the Commission by a number exceeding 2,000. The T. & N. O. will increase its force by 611. In arriving at the total of 38,447 men for whom work will be available, the Prime Minister includes 5,500 now on the permanent staff of the Hydro.

Sir William further stated:

"Important works in addition to these above outlined are under consideration, and these, if decided on, will entail considerable additional expenditure to that indicated, and it is not unlikely that a larger expenditure than above estimated will be made on some

of the works already decided on. The Department of Lands, Forests and Mines will also employ a considerable number of men during the spring and summer in fire and forest ranging, surveying, timber cruising, and in other work in the North."

"While a number of men are now engaged in highway construction this work will be extended to furnish the greatest amount of labor possible as soon as the weather and other conditions permit. Repair and renovation work has been started, and it is expected construction will be commenced upon one of the new Toronto university buildings very shortly. These buildings have been authorized at this time to help the labor situation, and work will be rushed with all possible speed with the object of giving the greatest relief possible. Tenders will be called immediately for certain work outside of Toronto and the whole programme will be proceeded with as expeditiously as circumstances will permit."

"In addition to the work above indicated the Government is using every effort to assist and stimulate private industrial concerns."

Compile Census of Industry

The Dominion Bureau of Statistics, Ottawa, are compiling a census of industry, and have issued forms to be filled up by various firms. The forms covering the building and constructing industry are very comprehensive, and include canals, harbors, telegraphs, telephones, roads, sewers, drains, building, etc. The firms are asked to give particulars of the value of all materials used during the year in the different constructive enterprises completed or partially completed. The cost of unused materials is not to be included. Sub-contractors have to make return only of materials supplied by themselves, while general contractors must make a return of all materials supplied by them to sub-contractors. The sub-contractors are asked to give the names and addresses of all firms doing sub-contract work during the year.

Col. C. H. Mitchell Will Continue With His Firm

In our last week's issue we announced the appointment of Lieut. Col. C. H. Mitchell as the new Dean of the Faculty of Applied Science and Engineering, University of Toronto. We understand, however, that, while assuming this new responsibility, Col. Mitchell will not sever his connection with the firm of C. H. and P. H. Mitchell, but will continue in active professional practice with it.

Montreal Branch A. C. B. C. I. Banquet

The Montreal Association of Building and Construction Industries will hold a banquet on February 27, at the Windsor Hotel, to which Ministers of State, municipal representatives and representatives of various constructional societies will be invited. The banquet is intended to inaugurate a vigorous campaign by the reorganized association with a view to extending its borders.

The Sherbrooke Construction Co. has obtained a contract for the construction of car shops at Newington, P. Q., for the Quebec Central Railway, the steel work for which will be carried out by the MacKinnon Steel Co., Ltd., Sherbrooke.

Good Roads' Measures in Quebec

The Hon. T. A. Tessier, Minister of Roads for the Province of Quebec, has introduced two Bills dealing with good roads. One is to facilitate the lending of money by banks for highway work. It provides that when a municipality has passed the necessary by-law to build a road and to get the money from the government, under the Good Roads Act, the municipality may, notwithstanding any provision of the general or special acts by which it is governed, borrow, from time to time, on notes, on a mere resolution, the money necessary to carry out, under the direction of the Minister of Roads, any of the work, provided that the total amount of the loans it contracts under this section shall not exceed the estimates of the road department. The rate of interest is also limited to 7 per cent.

The other bill is designed to continue the Government policy of seeing that all road work is done under Government supervision. The municipal code is amended by adding the following clause: Any work of construction, improvement, repair, or maintenance on roads or bridges may be performed under the direction of a supervisor appointed by the Minister of Roads. Such supervisor appointed by the Minister of Roads shall not be subject to the control or superintendence of the municipal inspector nor to the control or superintendence of the road inspector for the district where the work is being done. He shall receive from the corporation the remuneration fixed by the Minister of Roads.

Sir Lomer Gouin, replying to a deputation asking for the construction of a highway between Montreal and Sherbrooke, promised to give favorable consideration to a request for loans by the municipalities. The Government was not undertaking the construction of any highway as provincial roads, though if the municipalities bore the cost of them, the Government would see that they were properly constructed. The Premier said that it was necessary that it should be known that the Government was not lending money to the municipalities at 3 per cent., and have the municipalities use this money for local roads, and then expect that the main roads would be built at the Government expense.

At a joint meeting of the Board of Trade, Manufacturers' Association and other bodies, recently held in Vancouver, to discuss the development of Vancouver as an ocean port, a resolution was adopted urging the Federal Government to give immediate attention to the needs of Vancouver in this connection. Mr. W. G. Ross, chairman of the Montreal Harbor Commission, addressed the meeting, pointing out the great natural advantages of Vancouver as a Pacific terminal of the great transcontinental railways, and urging that no further time should be lost in at once proceeding with additional piers and port facilities. He also described how the port of Montreal had been built up.

The Quebec Government will introduce a Bill creating machinery for the expenditure of the Federal grant for housing. Each municipality will have power to create a commission for dealing with its portion of the money.

Revision of Building By-laws of Westmount, P. Q., Proposed

The City of Westmount, P.Q., has under consideration the revision of the building by-laws, and has asked the Montreal Association of Building and Construction Industries to consider the proposed alterations. At a meeting held on Feb. 6, the new code was discussed, together with suggestions for further alterations, the result of the experience of contractors and plumbers who have carried out work in Westmount. The important point, as was remarked by Mr. J. P. Anglin, who presided, was that the suggestions would form a basis when considering the building codes of other places adjacent to Montreal. The result was the appointment of three committees to put into definite shape the recommendations of the Association.

The plumbing and heating by-laws were first considered, the following being appointed to go fully into the whole subject appertaining to that branch—Messrs. Hughes, Ogilvie, Sanderson and Ballantyne. It was stated that the by-laws were excellent, but there was a want of clearness in the form, with the result that meanings were imparted to the code that were not originally intended.

On the question of the general code, it was suggested that the Provincial Code should be printed with the city code, as there were restrictions in the former that were not incorporated in the Westmount by-laws.

On the subject of unoccupied space, it was felt that a distance of 7 ft., as required for the side lines, should be a sufficient distance to keep clear of the rear lines. The opinion was also expressed that, as regards ceilings, a minimum height of 8 ft. for living rooms was desirable. A long discussion on the area of rooms took place, and it was recommended that 80 ft. should be the minimum, with at least one room 150 feet. At present there is a clause limiting the number of rooms in an apartment house to not less than four, which it was remarked prevented the building of apartments for bachelors. This clause, it was recommended, should be eliminated. The question of the height of apartment houses was also gone into, the present limit being four stories. It was recommended that six stories above the basement should be allowed. One main stair way for apartment buildings of not more than three storeys in height, containing not more than twelve apartments should be sufficient, with a fireproof wall separating each group of six apartments.

With regard to the thickness of walls, the general opinion was in favor of 8 in. walls in case of a building not over two stories high, with a party wall 12 in. thick, in place of 16 in. for foundations and 12 in. for other walls. No provision is made for the use of terra cotta or cement blocks with a rough cast finish, and the following committee was appointed to consider the entire question and the use of other materials than concrete, brick, stone and decorative terra cotta—Messrs. Dowsell, Johnson, Quinlan and Church. Included in this subject will be the use, in the case of a 12 in. wall, of 4 or 8 in. of terra cotta or cement blocks, provided that 4 in. of brick be used on the outside.

The following committee will further consider the general by-laws—Messrs. Anglin, Hughes, Irving and Quinlan.

Mainly Constructional

East and West—From Coast to Coast

Building permits issued in Galt, Ont., during January reach a total of \$25,000.

Work is stated to have been resumed on the Medicine Hat-Hanna railroad line in Alberta.

Clark Pressed Metals, Limited, has been incorporated with a capital of \$100,000, head office in Toronto.

It is reported that the Government proposes the construction of a lumber assembling dock at Vancouver.

In Stratford, Ont., there were 216 buildings erected during the year 1918, involving a total expenditure of \$89,786.

Canadian Electric Ore Smelters, Limited, has been incorporated with a capital of \$40,000, head office in Toronto.

The Kirkland-Hudson Bay Gold Mines, Ltd., has been incorporated with a capital of \$2,000,000, head office in Toronto.

The Cowain Flourite Mining Co., Limited, has been incorporated with a capital of \$100,000, head office at Peterboro, Ont.

Work is being started on the Kenilworth Ave. Sewer in Hamilton, Ont., This undertaking involves an expenditure of \$117,000.

The council of St. Boniface, Man., is calling tenders for the purchase and removal of the old Provencher bridge, closing February 24.

The council of Galt, Ont., has passed by-laws to raise \$35,000 for the waterworks department and \$50,000 for the hydro-electric department.

Samuel Bullock, Limited, has been incorporated with a capital of \$40,000, head office in Toronto, to do general building and contracting work.

Mr. Thomas Adams, of the Commission of Conservation, has drawn up a town-planning scheme for the city of St. John, N.B., to provide for development.

A normal school building is proposed to be erected at Saskatoon, Sask., at a cost of about \$300,000. It will be located on the university campus.

The Bishop Navigation Co., Limited, has been incorporated with a capital of \$1,500,000, head office at Montreal. This firm is authorized to build and operate ships.

It is stated that the Federal Government will co-operate with the Alberta Provincial Government in the construction of a new tuberculosis hospital for central Alberta.

The Grand River Railway Company is beginning work on the construction of a line between Hespeler and Preston, Ont., connecting the present line with the G. T. R.

Joseph Giroux, Limitee, has been incorporated, with a capital of \$30,000, head office at Saint Casimir, P. Q., for the purpose of carrying on a general contracting business.

The co-operative stockyards centre which the Saskatchewan government proposes establishing in the northern section of the province, is to be located at Prince Albert.

Robertson-Olsen, Limited, is the name of a recently incorporated concern, with head office at Ottawa, authorized to carry on business as engineers, machinists, blacksmiths, etc.

The President of the Nova Scotia Steel & Coal Company states that it is the intention of the company to develop its Wabana mines on a scale that will put it into a position to enter the ore markets of the world. Extensions and im-

provements to the company's plans, as previously noted, are also to be carried out.

Opinions expressed at a recent meeting of the council of Westmount, P.Q., were in favor of revising the building by-laws so as to permit of the erection of apartment houses and flats in that city.

It is estimated that there are at least 350 workmen idle in Guelph, Ont., and a deputation recently came before the city council to request that some public works be started at once to provide employment.

Hon. T. A. Crerar, Minister of Agriculture, announces that nearly a million dollars is being appropriated this year for the construction of a government cold-storage plant at Montreal. Work is to be started this summer.

The Cleaton Co. (Canada), Limited, has been incorporated with a capital of \$100,000, head office at Montreal. This firm is authorized, amongst other activities, to carry on the business of engineers, contractors and builders.

It is reported that the Cassiar Crown Copper Company, owners of the Cassair Crown mines on Grouse mountain, in British Columbia, have decided upon an extensive program of work in connection with the development of that property.

In the provincial budget of Saskatchewan, there is an appropriation of \$1,400,000 for highway expenditures, and \$1,260,300 for public works, chargeable to capital. Provision is also made for the erection of a new hospital for the insane to cost \$155,000.

The building permits issued in Hamilton, Ont., during the month of January reached a total of \$175,000, as compared with \$52,000 for the same month last year. Of last month's total, \$100,000 is for an addition to the plant of the Steel Company of Canada.

The new general catalogue of the H. Mueller Mfg. Co., Ltd., Sarnia, Ont., which will comprise 300 pages, covering the company's lines of water, gas and steam brass plumbing goods, is at present in the printer's hands and will be ready for distribution within a few weeks.

The Department of Soldiers' Civil Re-establishment has decided to establish a Dominion sanatorium for men returning from overseas suffering from tuberculosis, domiciled in Ontario. This will involve an expenditure of about \$320,000. A site has been secured from the Ontario Government.

It is the government's intention to proceed with construction work on the section of the line linking the city of Kamloops with the city of Vernon, B.C., during the present year, according to the statement of Hon. D. B. Hanna, Chairman of the Board of Directors of the Canadian National Railways.

The proposed ocean pier at Vancouver, for which the C. P. R. has made provision in this year's estimates, will probably cost about \$1,000,000. This pier is only part of a general extension of Pacific trade facilities planned by the company, it is said. It will likely be thrown out not very far from Pier "D."

Work on the new Anatomy Building and the Electrical Engineering building at the University of Toronto, which were recently authorized by the Provincial Government, will be started very shortly, probably within a week. For the former building the government has made a grant of \$200,000, and for the latter, \$350,000.

The public works committee of Guelph, Ont., has decided to take action to put the sewage disposal plant, which is an antiquated one, into condition to meet the present demands. Considerable sums of money are also to be spent on street repairs, and work is now being commenced on

some new sewers and a new drainage system for St. Patrick Ward.

In the period between December 1 and January 15, permission was given by the Saskatchewan local government board to 20 school districts in the province to borrow money, either for the purpose of erecting new schools or for making improvements to property. The total amount to be borrowed, according to the Saskatchewan Gazette, is \$42,550.

The bricklayers' union of Regina, Sask., has notified the contractors that on and after March 1, 1919, they demand that the hours of work be from 8 in the morning until 12 noon and from 1 until 5, excepting Saturday, when the hours will be from 8 a.m. to 12 noon. The rate of wages demanded is \$1.00 per hour, an increase of 20 cents over the previous rate.

Only four new buildings were erected in Fredericton during 1918, according to the annual report of Building Inspector George Ross, the total expenditure for all building operations in the city last year being \$171,450, most of which was spent on the new military hospital building. This is believed to be the lowest ebb to which building operations in Fredericton have ever dropped.

Application is made for the incorporation of the Quebec & Ungava Railway Company, which purposes to build a railway line from a point at or near Seven Islands, in the county of Saguenay and thence in a northerly direction to a point at or near Lake Menibek, and thence in a westerly or northwesterly direction to the most suitable harbor between the mouth of Big river and Nastapoka Sound, on Hudson's Bay.

A Memorial Victory Mall, or "Avenue of Triumph," is proposed in Winnipeg by the Greater Winnipeg Plan Commission, as a permanent monument to the men fallen in the Great War. This mall, according to the present suggestion, would be a magnificent boulevarded avenue, 132 feet wide and 2,000 feet long, extending from the Parliament Buildings to the corner of Portage and Colony Streets.

A company, in which Mr. Leon Fiset, of Eastern Harbor, C.B., is interested, proposes the construction of a railroad line extending from Inverness to Eastern Harbor, a distance of 37 miles, and another branch from Cape North to connect with Newfoundland, a distance of 67 miles. The object, it is said, is to permit the shipment of coal to Quebec and Montreal at much cheaper rates than exist at present.

In connection with the Civil Service Association's proposed scheme for the provision of homes for civil servants in Ottawa, the housing committee appointed by the association has recommended that the executive petition the government to sell or lease a portion of the area of the Experimental Farm now used for crops, or a part of the Rockcliffe range property. If such property is secured, it is proposed to lay out a model townsite.

A recommendation survey of the route between The Pas, Man., and the Flin Flon copper district is being carried out on authorization of the Canadian National Railway Board, as a result of representations by the owners of the copper deposits, who state that, at the lowest estimate, there is 25,000,000 tons of copper which they are unable to take out or treat without transportation. The cost of building the railroad is estimated to be \$2,000,000, including equipment.

The estimates presented to the government by the board of directors of the Canadian National Railway System, call for expenditures totalling \$60,000,000. The appropriations proposed are for additions to railway rolling stock and equipment, betterments and for completion of certain branch lines in Western Canada which are required for feeders for the system's main lines. Already orders have been placed for a large quantity of steel rails and accessories to be used in

making extensions of the national railways. Employment will be given to approximately 15,000 men.

The following are important public works included in the estimates of the Saskatchewan Government for this year: \$100,000 initial vote for war memorial museum to be built on the legislative building grounds, at Regina; new normal school building at Saskatoon, \$250,000; additions to the Saskatchewan university, \$134,000, for prosecution of physics research work; new court house, location not announced, \$150,000; initial vote for asylum for insane in south Saskatchewan, location not announced, \$250,000.

St. John is looking forward to an early extension of Negrotown Breakwater to Partridge Island. This breakwater is at present 2,250 feet long, and is of the rubble mound type, with concrete superstructure for about 946 feet. It was commenced in 1875 and completed in 1877. To make connection with Partridge Island will require a filling of about 1,500 feet. As a result of the construction of this extension the western channel into St. John harbor will be closed. The main purposes of the extension are (1) to protect the harbor from southerly waves and (2) to permit of the expansion of the west side pier facilities. A comprehensive system of piers is already planned for the greater part of the distance.

The Canada Gazette announces the incorporation of Sir John Kennedy, consulting engineer; Robt. Fulford Ruttan, doctor of medicine and professor of chemistry; John Bonsall Porter, doctor of science and professor of mining engineering; Richard John Durley, engineer; and Henry Hague Vaughan, engineer; all of the city of Montreal, for the following purpose: "(a) To co-ordinate the efforts of producers and users for the improvement and standardization of engineering materials; (b) To prepare and promote the general adoption of standards in connection with engineering structures, materials and other matters and things and from time to time to revise, alter and amend the same." The corporation is to be known as the Canadian Engineering Standards Association operating without share capital throughout the Dominion of Canada, with head office at Montreal.

Col. David Carnegie, who has recently returned from a tour of inspection of the markets and conditions in the Old Country, as related to the steel industry, recently addressed a meeting of steel men in Montreal. Col Carnegie was optimistic, pointing out that, though there is bound to be a slack period during the time when plants and machinery are being changed over in order to concur with peace time market demands, eventually the demand for steel products would be very great, because of the fact that great reconstruction programmes, carried out in the countries devastated by war, would demand such products and in most cases the industrial fibre of these countries had been so affected that it would be some time before they would be in a position to supply the demands of their own markets.

GOOD ROADS ACTIVITIES

A by-law has been passed in Carlton county, Ont., to raise \$40,000 to be spent on good roads this year.

At a recent session the council of Grey County, Ont., appropriated \$24,000 for road building machinery and \$98,000 for road construction and maintenance work.

Wentworth County, Ont., is aggressive in its good roads policy. Last year the outlay on improvements amounted to over \$72,000. Of this amount the provincial government will contribute \$20,000.

The council of Simcoe County, Ont., has decided to spend \$150,000 on road work, to be distributed as follows: \$17,000 for bridges; \$33,000 for towns and villages; \$30,000 for county-

provincial highways, and \$70,000 of the remainder on the county roads.

Municipal Engineer Milne, of Edmonds, B.C., has submitted estimates of expenditure during the current year as follows: Construction of roads, \$22,500; reconstruction, \$17,800; maintenance, \$42,330; sidewalks, \$8,400; sidewalk maintenance, \$1,600.

The York County Highways Commission will make application to the Ontario Department of Highways to have certain of the roads under their jurisdiction designated as provincial-county roads, including Yonge Street, outside the city limits of Toronto.

In a recent address, Hon. Finlay Macdiarmid, Ontario's Minister of Public Works, stated that the building of public highways in this province is to have precedence over all other forms of government expenditure which entail the outlay of large sums of the public funds.

The county councils of North and South Essex, Ont., plan to undertake a general road construction scheme this year. The necessity of providing work for returned soldiers as well as the direct benefit to be derived from good roads has influenced them in the determination of their policy.

A delegation of farmers from the counties of St. Hyacinthe and Rouville recently interviewed Hon. J. A. Tessier, Minister of Roads for the Province of Quebec, urging the construction of a public highway from St. Hyacinthe to Marieville. The length of this road would be 17 miles.

The Central Ontario Provincial Highway Association was formed at a recent meeting at Stratford, when some 150 delegates from many municipalities between Sarnia and Toronto gathered to inaugurate a campaign for a provincial highway from Toronto to Sarnia, via Stratford. A deputation is to be appointed to lay this highway project before the government.

As a result of a recent visit to Orillia, Ont., and a conference with the town council on the matter of street paving, Engineer E. A. James, of Toronto, was instructed to complete plans and specifications and to call for tenders for paving Mississauga Street from the Lake to O'Brian Street; Front Street from the G. T. R. Station to Neywash; Peter Street and West Street from King to Coldwater. It is hoped to have the tenders in during March, and to begin the work as soon as the frost is out of the ground.

Work of a substantial nature is to be undertaken by the Ontario Government this summer upon the provincial highway between Toronto and Bowmanville, according to the recent statement of the Minister of Public Works. The recent announcement that tenders were to be invited for 100 miles of this highway, will be recalled, and it has been announced by the Minister that this will include the building of the Ottawa-Prescott section, a stretch of 56 miles. The old stone road between Hamilton and Queenston is also to receive attention.

A deputation from Wentworth and Haldimand counties recently waited on Hon. F. G. Macdiarmid, Minister of Public Works and Highways for the Province of Ontario, requesting that the Province designate as provincial-county roads the highway from Hamilton to Port Dover and the Talbot road, running from St. Thomas to Niagara Falls. The portion of the Hamilton-Port Dover road within the county of Wentworth has already been improved for almost its total length by the county. Mr. Macdiarmid said he would give the request most favorable consideration.

In his second annual report, Mr. G. R. Marston, C. E., county road superintendent for Norfolk county, gave a statement of the 1918 expenditures which is summarized as follows: Road construction, \$6,685.12; bridge construction, \$4,829.56; maintenance, \$14,486.25; general, \$6,886.54. As to fu-

ture plans, Mr. Marston proposes working out a programme of road-building to extend over some years, so that preparatory work of drainage, grading and putting in culverts may be systematically carried along a year or so in advance of metal-ling, and suggests the appointment of a committee to draw up such a programme. He also expresses his disapproval of the present statute labor system and suggests its commutation. The building of eight culverts and bridges, ranging from eight to 55 ft. span, is recommended in the report.

A deputation from the municipalities on the south shore of the St. Lawrence from St. Lambert to Dundee has requested the Quebec Government to give assistance in building a highway along the bank of the river between the two places named, to link up with the state road at Fort Covington and other parts of New York State, and thus prove an additional means for New York tourists to visit the province, at the same time enabling the agriculturists of the district, tapped by the highway, to have better means of inter-communication, and to get their produce to market with greater ease. The proposed highway is 68 miles long. The government is asked to provide the necessary loans for the cost.

Personals

Mr. E. A. Cleveland, of Vancouver, has been appointed by the Provincial Government consulting engineer in connection with the development of the South Okanagan lands recently acquired for soldier and general land settlement.

Mr. W. H. Fairchild, city engineer of Galt, Ont., has been appointed manager of the Galt Public Utilities Commission and will be in full charge of both the Hydro and Waterworks Departments.



Mr. Nelson D. Porter, ex-Mayor of Ottawa, who was elected President of Eastern Ontario Good Roads Association at recent Ottawa Convention

Mr. Lawford Grant, who has severed his connection with the Eugene F. Phillips Electrical Works, Ltd., Montreal, was on February 8 entertained at dinner at the Engineers' Club, Montreal, by the staff of the company, and presented with a mahogany clock.

Mr. H. H. Boyd has been appointed assistant chief mechanical engineer of the C. P. R. He is a graduate in applied science of McGill University, and has been with the C. P. R. in several engineering capacities, including assistant electrical engineer, and electrical engineer for the Western lines at Winnipeg. In 1916 he was appointed superintendent of the Vancouver division, a position he now vacates to reside in Montreal.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Beauce, Que.

County Council plans construction of roadways from St. Georges Beauce to Lake of the Englishmen. Engineer, M. Henry, Quebec.

Brantford, Ont.

Tenders are being received by clerk, J. A. Smith, Court House, until noon, March 1st, for construction of culvert costing \$4,500 for Township Council.

Burnaby, B.C.

Municipal Council plans to pave Britton, Edmonds, 6th, Government and Cambridga Sts., Gilley, Sterling, Esmond, Patterson and Inman Aves. and North Rd. Engineer, Mr. Milne.

Edmonton, Alta.

Excavation is completed for \$30,000 addition to filter plant for City Council. Clerk, Chas. E. K. Cox.

Estevan, Sask.

City Council plans waterworks extension costing \$12,000. Clerk, W. F. Thompson.

Finch, Ont.

Tenders are being received by superintendent, J. G. Cameron, until 7.30 p.m. February 28th, for repairing fifty miles of road with crushed stone and draining same for County Councils of Stormont, Dundas and Glengarry.

Gould, Que.

Plans and specifications are with the secretary-treasurer, Arthur B. MacDonald, who is receiving tenders until March 3rd, for construction of eleven miles of Sherbrooke-Beauceville roadway for municipality of Lingwick.

Grand Mere, Que.

County Council plans construction of roads from here to Gervais Junction. Clerk, D. G. Trudelle, St. Genevieve Le Batiscan.

Guelph, Ont.

City Council has instructed engineer, F. McArthur, to prepare plans for sewage disposal plant.

Town Council plans paving several streets. Clerk, T. J. Moore.

Hamilton, Ont.

Department of Public Works, Toronto, plans construction of auxiliary to old reservoir costing \$15,000. Minister, Hon. F. G. MacDiarmid, Parliament Bldgs., Toronto.

Work has started for Kenilworth storm sewer for City Council. Clerk, Sam. H. Kent.

London, Ont.

Work will start in Spring for cement walks, curbs and gutters costing \$44,000 and paving costing \$125,000 for City Council. Clerk, S. Baker.

Mimico, Ont.

Work will start in Spring for sewers on Louise, Victoria, Warden and Symons

Sts. for Town Council. Clerk, J. A. Telfer. Council will purchase material.

Montreal, Que.

City Council plans extensive paving program. Clerk, Rene Bauset.

Muncey, Ont.

Tenders are being received by clerk, John Brodie, until March 3rd, for construction of Marsham drain for Caradoc Township Council.

North Vancouver, B. C.

District Council plans paving Rubson Road. Clerk, G. J. Farmer.

Perth, Ont.

City Council is issuing debentures to expend \$100,000 for roads. Clerk, W. A. Moore.

Port Rowan, Ont.

Town Council plans construction of drainage system. Clerk, W. A. Mabey.

Quebec, Que.

Department of Roads, Quebec, plans construction of road from Sherbrooke to Miller's Bridge on Maine frontier. Engineer, M. Henry, Parliament Bldgs.

R. C. Harris, Works Commr., City Hall, has approved recommendation of grading Gerrard St. and the extension of north section of Hastings Ave. at cost of \$53,00.

St. John, N.B.

Tenders are being received by Commissioner of Public Works, G. F. Fisher, until March 10th, for 375 tons of asphalt cement, 80 to 85 degrees penetration, and 25 tons of asphalt cement, 60 to 65 degrees penetration, for City Council.

Sturgeon Falls, Ont.

Town Council plans construction of concrete roads. Clerk, L. Rod Vannier.

Toronto, Ont.

Tenders are being received by Department of Highways, Toronto, until February 28th, for construction of fifty miles of highway on the Ottawa-Prescott highway.

Board of Control plans laying pavement costing \$39,000. Engineer, R. C. Harris, City Hall.

Tenders will be called for construction of thirty reinforced concrete culverts for Department of Public Works, Toronto. Minister, Hon. F. G. MacDiarmid.

Valleyfield, Que.

Municipal Council plans construction of road "Salaberry Blvd." Sec.-treas., L. J. Boyer.

Vancouver, B.C.

Water Commission, City Council, plans construction of water storage costing \$10,000. Clerk, Wm. McQueen.

Victoria, B.C.

Board of Works, City Council, plans laying pavements. Engineer, F. M. Preston.

Windsor, Ont.

Plans are being prepared and ten-

ders will be called shortly for construction of fifty miles of highway between here and Quebec for Department of Public Works, Toronto. Minister, Hon. F. G. MacDiarmid, Toronto.

Woodstock, Ont.

Plans are drawn for sewer costing \$40,000 for Board of Works, City Council. Clerk, Jno. Morrison. Engineers, F. J. Ure, Woodstock & Chipman & Power, Mail Bldg., Toronto.

York County, Ont.

County Council has passed an appropriation of \$100,000 for county roads and \$16,000 for maintenance.

CONTRACTS AWARDED

Sandwich, Ont.

Sewers costing \$32,000 for Town Council: General contractor, Merlo, Merlo & Ray, 296 Windermere Rd., Walkerville, will purchase material.

Railroads, Bridges and Wharves

Barrington, N. S.

Work will start in April for bridges and roads for Department of Public Works, Halifax. Engineer, W. G. Yorston, Halifax.

Bowmanville, Ont.

Tenders are being received by Department of Public Works, Toronto, until February 28th, for erection of \$35,000 structural steel bridge. Minister, Hon. F. G. MacDiarmid, Parliament Bldgs., Toronto.

Edmonton, Alta.

C. N. Rly., Toronto, plans railway improvements costing \$750,000. Supt., J. Irwin.

Finch, Ont.

Tenders are being received by superintendent, J. G. Cameron, until 7.30 p.m., February 28th, for construction of reinforced concrete bridge for County Councils of Stormont, Dundas and Glengarry.

Gravenhurst, Ont.

Plans are drawn for station for G. T. Rly., Montreal. Supt., P. J. Lynch, Alandale.

Hornsby, Ont.

Plans are being prepared for reinforced concrete bridge for Halton County. Clerk, Wm. Panton, Milton. Engineer, Bowman & Connor, 31 Queen St. W., Toronto.

Manitoba, Province of

C. N. Rly., Toronto, plans railway extension from Amaranth twenty miles toward Winnipegosis. President, D. B. Hanna, Toronto.

Odessa, Ont.

Tenders are being received by Department of Public Works, Toronto, until February 28th, for construction of structural steel bridge costing \$7,000.

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Production with Conservation

THE great economic problem to be solved by the Government of this country—and, indeed, of most others which have been involved in the war—is to strike a proper balance between thrift, on the one hand, and outlay for the purpose of providing employment, on the other. The need for economy is quite apparent, in consideration of the enormous war expenditures which have had to be borne, and the uncertainty as to conditions in the immediate future. But, at the same time it is most certainly imperative that the governments, federal, provincial and local, make large expenditures on public works so as to relieve the unemployment situation.

Many branches of industry are faced with entirely unprecedented conditions. Their markets are inactive or, in some cases, closed, and they have a surplus of labor, while, at the same time, increased wages and shorter hours are demanded. They are thus placed in a position which makes readjustment to normal operations very difficult. The necessity for good wages is natural enough in view of the high cost of living, but the great trouble now seems to be that as soon as wages are raised, living costs automatically take a corresponding jump, and conditions are in no wise relieved. Indeed, it appears that we are facing a financial

crisis, demanding either decreased profits or increased per capita production. For if our products continue to increase in cost we will be unable to compete successfully for export trade in the world's markets.

Whether or not it is possible or feasible that there should be a decrease in profits on invested capital is a debatable question, and one which would require discussion at great length. We therefore turn to the alternative, increased production. If wages are maintained at their present level, or are raised, while at the same time hours are shortened, the individual workman must increase his rate of production, otherwise there is the danger of a reaction which may result in bankruptcy. It is doubtful to what extent labor realizes this fact. The Bolshevik element ignore it entirely, and the consequence of the application of their ideas in Russia is the practical insolvency of that great country. However, it has been proven that with short hours and good living conditions, a man's rate of output can be very considerably increased, and if the working day is shortened labor must be educated to the necessity of higher pressure operation.

There is another element in increased production, however, besides increased per capita output, that is, conservation. This question of conservation is a very broad one, having to do with almost every department of our industrial and national life. Its principal idea, however, is, first, the elimination of leaks, and second, economic development and use of the country's resources. In the later field, the government appears to be taking hold of the problem with a full realization of its importance, but there have been, and still are, appalling leaks in the industrial and economic structure of the country. One of the most obvious and most wasteful of these leaks is our fire loss—we have an annual bonfire in which millions of dollars goes up in smoke. This waste is a great drain on both our resources and organization, and is a very effective check upon our rate of production. If we are to compete successfully in the world markets under present labor conditions and on our ability to do so, Canada's future, to a large extent, depends—it must be very greatly reduced. Investment in fire protective equipment, fire resistant structures, proper town-planning, and the re-planning of districts which are unsafe from the standpoint of fire-protection, will yield big returns. Therefore let us start the new era, which is marked by the year 1919, with the determination to "fight the fire fiend." Let Canada's government and her industries take for their motto—production, conservation, fire-prevention.

Reduce Cost of Estimating Department

IN view of the excessive cost of building, it is the duty of every one interested in the industry to do his utmost to reduce the cost wherever possible. This high cost is all that stands between the building contractors and material supply men, and exceedingly prosperous times. The buildings are required, there is a good supply of all materials, and the labor problem is a thing of the past. The price of labor is determined by the cost of living and is more or less a fixed quantity. The opinion generally expressed is that it would be very unwise to attempt any wage reduction at the present time. Regarding

prices of building materials, it appears to be generally conceded that any reduction will be gradual.

A careful survey of the situation fails to uncover many opportunities for effecting a saving, but such opportunities as do exist should be made the most of in an effort to eliminate leaks in operation and reduce to a minimum the long over-strained, overhead charges.

A very large item in the contractor's expenses, that is charged to overhead, is estimating. Considering for a moment the volume of work on which a contractor has tendered in a year and comparing this with a total of contracts awarded this man, it will be discovered that he has figured on a tremendous amount of work unsuccessfully. It has cost him a considerable sum to prepare his estimates for this work and this cost has been duplicated by every man figuring on the work.

It would appear that this unnecessary duplication of work could be eliminated, to a great extent, by calling in the services of some such individual as a quantity surveyor. For a number of years he has had a recognized position in the industry in England. Every job passes through his hands, and a complete table of quantities for every trade is taken off by him, a copy of which is handed to the contractors invited to tender. In this way each man tendering on the work is figuring on the same quantities, and a much closer and more accurate price is quoted in addition to saving the work of each tenderer taking off his own quantities.

It is in such details as this that an opportunity offers for the builders exchanges and allied organizations in Canada making a concerted effort to eliminate unnecessarily duplicated labor, which would result in a marked reduction in operating expenses and in this way reduce the cost to the owner.

Expenditure Well Warranted by Results

ONLY by the actual testing of structural materials and methods under conditions approximating those met in service can a safe criterion be formed by which to judge their behaviour in practice. The vagaries of material composition and the inconsistencies of human workmanship preclude an absolute degree of structural uniformity and render generally inoperative any law based solely on a theoretical consideration. Research in the testing laboratory, therefore, is alone the safe guide to dependable information relating to the strength of materials, and only when suitable experiments are properly conducted along purely practical channels, can any safe forecast be ventured regarding the behaviour of structures or structural materials under load.

The City Architect's department of Toronto in planning their revision of the building code, have not failed to keep this viewpoint in mind, and before incorporating a structural ruling, have endeavored to secure sufficient evidence to verify the correctness of its application, or lacking such proof, have sought to procure an amendment on the basis of experimental substantiation. The efforts of the department to determine, by full load tests, the structural conditions pertaining to flat-slab concrete, as described at various times in the Contract Record, will illustrate this, and in our last week's issue, Mr. W. W. Pearse's description of brick tests is a further indication of the policy of this department to secure fundamental in-

formation before attempting to make legally-binding rulings for all brick buildings coming under his jurisdiction. While the information is but preliminary, it is the beginning, we hope, of a completely tabulated set of results so that a dependable knowledge of the behaviour of brick buildings will be available.

The lack of specific knowledge about brick is admirably illustrated by the requirement in most of our building codes for 9, 14 and 18 inch walls—apparently the only recognized standards—which are mere conventionalities, ungoverned by any well-defined knowledge of the behaviour of the material and not taking cognizance of the differing qualities of brick and workmanship. The sum total of the available data on brick behaviour is rather meagre and, apparently, experimenters, on the whole, have not considered the value of the individual brick, nor the relation of height to thickness. So the fund of information is not complete, nor, indeed, of a great degree of usefulness.

The preliminary tests carried out by Toronto included the determination of the compressive strengths of all varieties and qualities of brick manufactured or sold in the city for structural purposes, followed by service tests of brick piers of the poorest quality brick, laid with not more than average workmanship. The tests were computed for columns of a sufficient number of slenderness ratios to determine a reasonable strength curve. This preliminary step is a commendable beginning and the lack of available data is sufficient authority for taking further steps along this line. The interests of the brick manufacturers and of conscientious designers and builders should make it worth while to continue tests with brick of all the other grades, with the idea in mind of collecting sufficiently comprehensive information to unfold the entire life history of brick.

The only handicap has been lack of funds sufficient to carry out anything on a large scale, but the inclusion of \$500 in the estimates of the City Architect's department for 1919 will, it is believed, make adequate provision to enable a further programme of development to be carried out. That the estimate will be passed by the Board of Control—already having passed the Property Committee stage—may, we believe, be taken for granted, when the Board recognize the necessity of this work. Five hundred dollars, in itself a meagre sum, will give profitable returns to the city of Toronto as a whole, through the savings that such a knowledge of brick behaviour will insure. The Board of Control would not be ill-advised if they were urged to spend far more than \$500 in continuing tests so well begun by the City Architect's department, in co-operation with Professor Gillespie and Mr. Marshall, of the University of Toronto.

Building Prospects in Montreal

THE Montreal building season has commenced with a promise of better things. Prices in certain directions are slightly lower, but labor is still high, and labor is the most important factor in the cost of construction. The outstanding feature will be the construction of houses made possible by the Federal and Provincial grants, and plans are now being laid to this end. The suburb of Outremont also has a building scheme, but for better class dwellings. Up to the present the largest work contemplated is the Government cold storage warehouse

on the harbor, while plans for a second cold storage building for private owners have been drawn. Three or four large apartment houses—one of ten stories—will be constructed; several garages, including public garages, will be put up; a large furniture factory is to be built; and extensions to a steel foundry, a maternity hospital, the lengthening of the civic conduit, a fire station, an abattoir to cost \$150,000, the remodelling of a theatre, the construction of two schools, costing, respectively, \$150,000 and \$200,000, and a large church at Lachine are among the jobs either actually contracted for or contemplated. The harbor commissioners will recommence work on the harbor improvements. Then among the ambitious schemes which may or may not be carried out, there are the proposed hydro-electric developments at Back River, the plans for which have been drawn. They are in effect rival schemes, and both involve the expenditure of millions of dollars.

Coming to the province, it looks as if Three Rivers will be a very busy spot. To begin with, there are reports of developments in the pulp and paper industry, including extensions to present plants and the erection of newsprint and pulp mills, with a large hydro-electric scheme. Two hundred industrial houses are to be erected according to advices from the city, while a dry dock, dredging and extensions to the ship-building facilities point to a belief in the permanence of that recently established industry.

The city of Quebec has a fair programme, including a military hospital and some schools; Shawinigan Falls will continue to expand owing to the increasing number of industries located at this source of cheap power; and Sherbrooke has a moderate amount of work, with an addition to a cotton factory, and buildings for the Quebec Central Railway. At Chicoutimi there will be extensive additions to the pulp and paper mills, and also the rebuilding of the cathedral which was destroyed by fire. In other parts of the province some large churches are to be built; a number of iron bridges erected, and a considerable amount of highway work done, as the provincial government is still carrying out its policy of adding to the good roads of the province.

Technical Bureaus Being Established Without Delay

IN our last issue we made reference to the great need of some government medium through which the returned technical men can be brought in touch with the various individuals, companies and municipalities who are in need of engineering assistance. Action has been very prompt and we are glad to be in a position to say that the government has considered the plan put forward by a number of engineers favorably and that details are being rapidly worked out. It is possible that by the time this reaches our readers some of the offices will have already been opened and placed in charge of technical officers. As far as possible the technical bureaus will be in close proximity to the employment bureaus already established by the government though the two departments will of necessity be separate on account of their entirely distinct fields of action.

In order to make these bureaus a success it will be necessary that they have the co-operation of all employers of technical men and more particularly the larger organizations that can absorb larger numbers. It is not possible yet to announce the exact location,

but any information or inquiry addressed to the government Employment Bureaus and marked "technical" will doubtless, in the meantime, be properly re-directed. As soon as it is possible to gather the information it is planned to have on file, on the one hand, lists of all technical positions vacant, with particulars, and, on the other hand, lists and qualifications of technical men who are out of employment. Primarily this clearing house is intended for returned men, but, if it proves of sufficient value, may doubtless be extended in scope.

The head of the organization, we understand, will be in Ottawa and the present plan is to open technical bureaus in about ten or a dozen of the larger centres only—Toronto, Montreal, one or two cities in the East, Winnipeg, Vancouver, and two or three western intermediate cities.

A Substantial Saving

In view of the high cost of asbestos paper, the Roofers' Branch of the Toronto Builders' Exchange has been urging its abolition under roof coverings of certain types where specifications or civil building codes usually require it. Through the instrumentality of this organization, the city architect's department of Toronto has investigated the current ruling and suggested, with the approval of the Chief of the Fire Department, an amendment, which has been passed by the committee on property, and needs only the approval of the Board of Control to make it effective.

The building by-law for a long term of years, required one ply of asbestos paper weighing not less than 14 lbs. per 100 sq. ft. under such roof coverings as felt and gravel, slate, tin, iron, tile and shingles. As asbestos paper, before the war, was a reasonably cheap commodity, the advisability of using it was not questioned. This material has, however, advanced in price during the last three or four years to an amount that builders and roofers claim to be money wasted when laid on certain types of roofs. The amended ruling will not insist upon the employment of asbestos paper under the roof coverings mentioned, and in this way will decrease the cost of building to quite an appreciable extent, without injuring to any great degree the fire retarding properties of the roof construction.

The deputation, which was introduced to Mr. Pearse, the city architect, by Mr. W. E. Dillon, consisted of Messrs. Dillon, Stewart, Matthews, Furnival, Douglas and Fisher. The arguments advanced were discussed at length, and finally endorsed by the city architect's department.

The elimination of asbestos paper will mean a saving of approximately \$2.25 a square in roof construction, which in the year just past would have meant a saving, in Toronto alone, of between \$25,000 and \$30,000. Mr. Pearse's recommendation was that Building By-law No. 6401 be amended, as follows:

1. By striking out the words "if put on in the following manner" at the end of Sub-section (1) of section 48.

2. By striking out the whole subsection (3) of section 48.

3. That the second paragraph of subsection (1) of section 141 be amended by inserting after the word "limit" in the first line of the said paragraph the words "except those of felt and gravel or those of slate, tin, iron, tile or other equally fire resisting material."

St. Catharines' Relief Sewage System

Survey Made with Idea of Serving Whole Area
Between the New and Old Welland Canals

By D. H. Fleming, B. A. Sc., A. M. E. I. C.

THAT portion of the city north of Welland Ave. and situate between the new and old Welland Canals, had been sewered in a very haphazard way, and without or contrary to engineering advice. In several instances a sewer constructed to serve the street in which it was laid was required to serve as a trunk for all intersecting streets and adjoining areas, as these cross streets were sewered. The outlet for the whole area was only a 24 in. tile on a

2nd, 1916, at Shaft No. 1, cor. Ontario and Carlton Sts.

Brick Designs the Cheapest

Although bids were called for a two-ring brick sewer in tunnel at about 30 feet deep, contractors were permitted to submit prices on any standard construction. Maguire's price was based on brick construction and was the lowest.

The contractor's equipment consisted of a two-drum hoist; "A" frame derrick, three or four flat trucks with steel skips and about 800 feet of light track, electric wiring, etc. Two to three teams with an extra dump wagon served each shaft. Two shafts were operated each with the above equipment. The only buildings required were an engine room; dressing room at each shaft and a cement and supplies shed at the siding. Cement was stored under tarpaulins at each shaft except No. 2 where the shed was used.

Materials for construction were brought in on electric railway sidings, no hauling whatever being required for shafts Nos. 1 and 2. Hauling was the means of transport to the other shafts, with dump wagons, a practice that should be discouraged, for the hauling of brick.

The excavation was moist blue-clay as had been indicated by borings supplied at time of calling for tenders.

Mining was done during the day and the brick was laid each night. In the 72 inch sewer, 7'-6" bore, four miners and one mucker composed a heading gang. Two such gangs, a signaller and hoist-runner on top completed the shaft crew.

Daily Progress Averaged 10 Feet per Heading

A pioneer notch is made on each side of the heading with grubs and the core cut out in long strips



View showing method of handling material

very flat grade. After every thaw or freshet and especially in case of a sudden mid-summer squall following a period of dry hot weather when the surface was baked almost to imperviousness, many cellars were flooded as well as store basements. This caused considerable damage, annoyance, expense, and threatened the health of the city.

A survey was made and a relief system designed to serve the whole area. This plan called for a sewer along Carlton street, consisting of

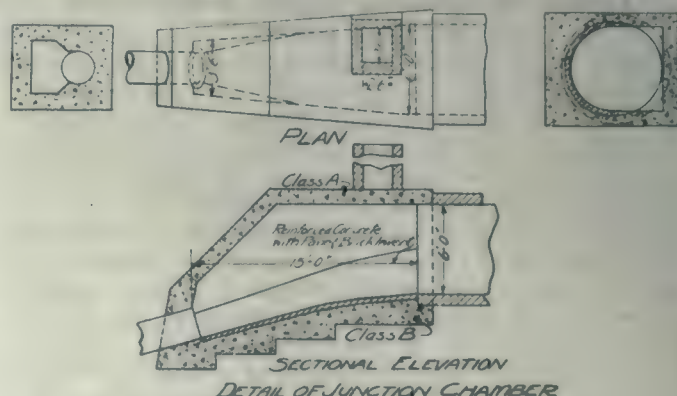
1190'	of	72"
2984'	of	54"
1640'	of	48"
812'	of	42"
1244.5'	of	36"

with a short steep out-fall of 24" C.I. A branch was built southerly along Thomas to Dufferin St. and east along Dufferin and Maple St. etc., to Berryman Ave., consisting of

6469'	of	60"
2750'	of	54"
970'	of	42"

with spurs to intercept the existing sewers, where relief was required. The whole plan involved an expenditure of about \$300,000, based on 1915 prices.

As a beginning the Council authorized the construction of a mile of the larger sizes. Contract drawings were prepared and contract let to John Maguire & Son of Toronto. The first brick was laid on Aug.



Detail of Junction Chamber of St. Catharines Relief Sewer

with semi-circular blade draw-knives. It is then loaded into a steel skip pushed to the shaft, hoisted and dumped into a dump wagon. It was hauled less than a mile and disposed of on a steep side hill owned by the city. Here three men were employed. These wagons were used all winter, but had to be unloaded partly by hand in very cold weather, especially when



Plan of Relief Sewers north of Welland Ave., St. Catharines

the clay was unusually moist and so froze to the box in transit.

The miners made 10 or 11 feet nearly every day. Occasionally a hard spot was encountered which slowed them up materially for a day or two, and after each pay-day we were short-handed. This was quite serious at first, but after the memorable Sept. 20th con-

Section of work under construction

ditions improved. Each heading was drifted about 400 feet before meeting the miners from the next shaft. No special provision for ventilation was found necessary.

The night gang consisted of a bricklayer, his helper and bucket man on each heading, one signaller, one hoist runner and three laborers supplying mortar and brick. A small day gang, augmented by some of the night men working over-time, unloaded brick, screened sand and thawed it in readiness for the night crew. During the winter weather sand was heated with steam coils and the water heated by exhausting steam into the barrel.

On one occasion two steel cars arrived with the sand frozen solid from top to bottom. Every means except blasting was resorted to and finally the cars were sent out half-full of frozen sand; after that sand was hauled some three or four miles from local pits and the lake shore.

Every shaft was dry and clean, except the last one, No. 6. Here we encountered water-bearing gravel at 11 feet down. As we later found out, this was only a seam and might have been missed 50 feet either way. Attempt was made to de-water this, but it proved a never-failing stream. A duplex pump was installed in one corner of the shaft, and the men worked knee-deep in water to get the shaft down. A test hole showed good clay 7 feet farther down and about 4 feet above the crown of the sewer. This was slow and tedious work, and delayed progress so much that shaft No. 5 was done before drifting commenced at No. 6.

Finally grade was reached; the pump installed in a sump and two rough rings of brick laid in a deluge of water. Drifting was then commenced, roof boards having to be used for the first time on the job. After a few days the men in the heading were working in the dry again, but the muckers and bucket men on the night shift had to be supplied with waterproof outfits. An extra man had to be supplied on each shift to push the car on the down-stream side, for in spite of everything the night engineer had to sleep and let the water rise in the tunnel. This made the rails and run very slippery.

100 Feet a Week at this Shaft

As this was the only shaft operating we had the pick of the bunch and three of our best miners made 100 feet in one week in 6'-6" bore, and the bricklayer kept up to them. The surplus men were now working on manholes which had to be forgotten up to this time, because of scarcity of labor.

Excellent brick for the work was supplied by the Cooksville plant. Canada cement was used and the gravel came from near Brantford.

The second and third contracts on this work were let to McLaughlin Bros. of Ottawa in the summer of 1917, and consisting of 3,640 feet of 60-inch along Dufferin and Maple Sts. and 5,500 ft. of 54 inch and 36 inch along Carlton St. being a continuation in each case of the work covered by the first contract. As previously the successful tender was on brick for the tunnel



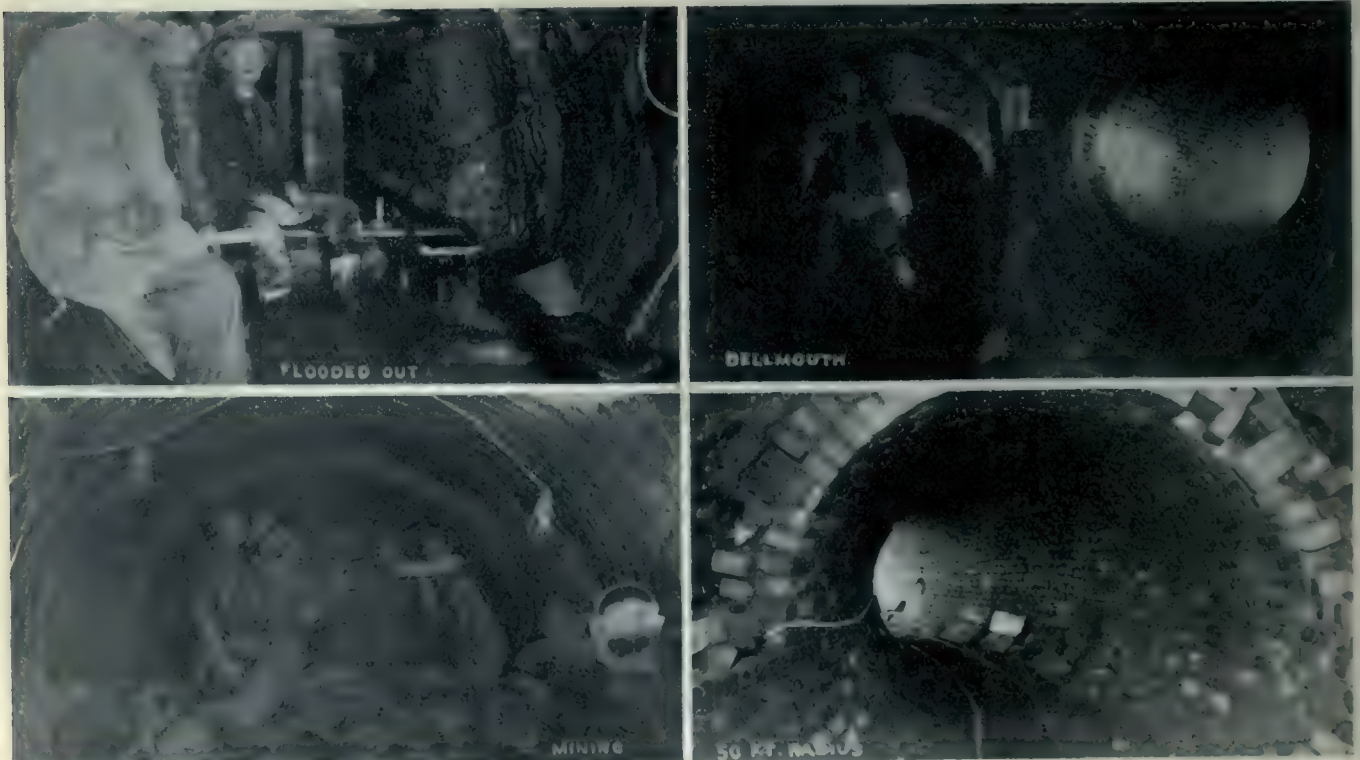
sections, but segment block on the 42 inch and 36 inch, which could best be handled in open cut, due to the smaller size, harder clay and shallower cut.

The contractors brought with them four carloads of equipment and built sheds to equip four shafts. Owing to the unusual scarcity and fickleness, to say nothing of the inefficiency of labor only two shafts could be operated at a time. This, after all, was very good progress. The plant used was a drum hoist, "A" frame derrick, skip cars and rails for each shaft.

A large hand derrick was used at the dump and a small hand derrick on manhole work. Two Ford trucks and a Ford car performed many varied services. Buildings consisted of an engine-house, dressing room, and cement shed at each shaft, an office, tool room, blacksmith's shop, three vehicle garage and a laborers' camp.

Dump Wagons Destroyed Brick

As formerly, electric sidings were convenient, but all brick and sand and segment blocks had to be haul-

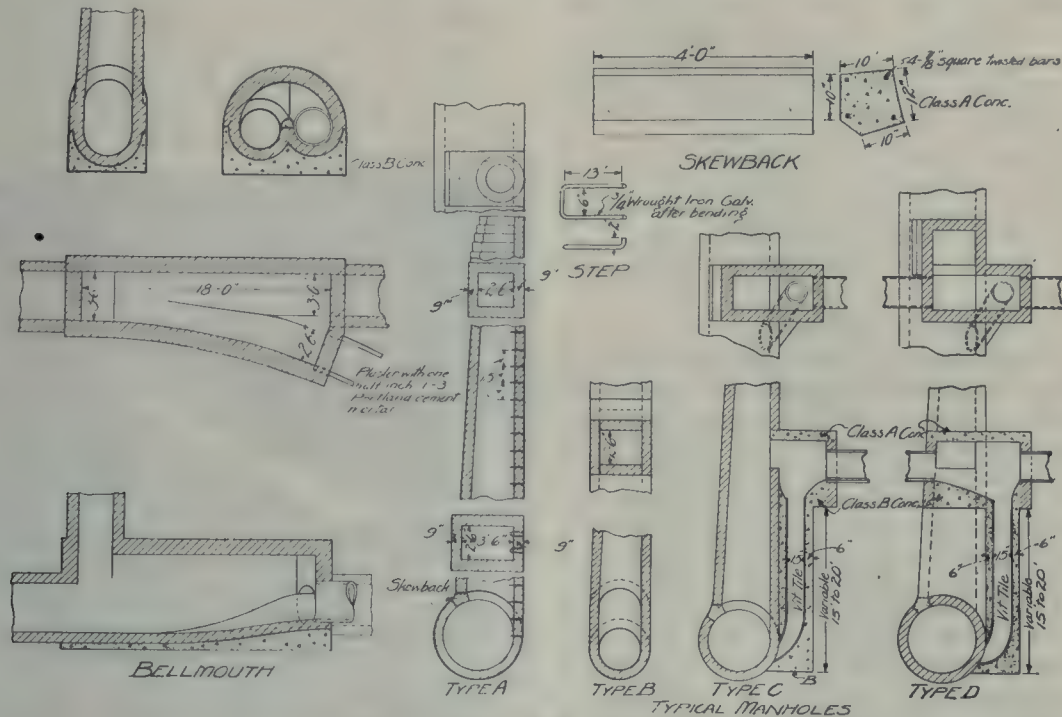


Illustrations show methods of tunneling and difficulties experienced in underground work; also sections of completed work

ed a short distance. At first stake wagons were used for brick but later the temptation to unload quickly could not be resisted and dump wagons were pressed into service. This proved very costly and destroyed a great number of the bricks through breakage and smearing with mud.

The tunnel material on these two jobs was a good deal like the previous one, except that it became harder and less tough 'as the bore shallowed up on Carlton St. On Dufferin street and Maple street every

ly the timbers were not taken out carefully and the shaft and partly constructed manhole was lost. A bulk-head had been built in the down-stream end, but no manholes were constructed. A laborer who was working in the tunnel when No. 5 gave way got out just a few minutes before egress was cut off. An old overloaded sewer in the street was broken and the tunnel filled with water. Attempts to pump this out had to be abandoned. The shaft was sunk again and the manhole rebuilt in water. The services



Details of Typical Manholes, Bellmouth and Skewback, St. Catharines Relief Sewer

shaft but one was wet about 10 feet below ground level. In spite of puddling and pumps the tunnels were always slushy and two men were required on each truck where formerly one had served.

Work was conducted in much the same manner as in the first contract and need not be recalled here. Special difficulties, however, presented themselves, and these may be of interest. Sand from local pits at Fonthill and Stanford was used. This was quite loamy and had to be mixed with lake sand occasionally. It set very slowly and was a constant source of annoyance and anxiety.

The brick were to have been supplied by the Dominion Sewer Pipe Co. of Waterdown. These, however, were too soft, and after much culling and costly delay they were abandoned. The contractors then at considerable extra expense, brought brick from La Prairie, Quebec. These were very impervious and uniform but not tough.

Shaft No. 3 was on private property belonging to a factory operating on shells. Much delay occurred in getting permission and erecting wire entanglements before access to the property could be had. In the meantime shafts 4 and 5 were completed. Water was encountered while sinking these, but the tunnel was good impervious blue clay just enough so to be easily mined.

Ejectors had to be operated continuously except for a few days when shaft No. 4 froze up.

When building the manhole at No. 5 unfortunate-

of a bricklayer used to such work was appreciated here.

Shaft No. 3 was by now down to grade without mishap, a clay puddle having first been put in a few feet outside and around the shaft. In a few days warm weather showed that this puddling had not been thoroughly done and the usual trouble with water occurred. Indeed fracture of the clay around the shaft and directly beneath the puddle imposed greater pressure on the walings than they were intended to bear and they were snapped and had to be replaced. The junction between shafts Nos. 2 and 3 was made first and when the junction between 3 and 4 was made, of course we were drowned out. The clay held up and the bulkhead was gradually removed and the gap bricked in the following night. This was the completion of the contract on Dufferin and Maple Sts.

Sleighs Used to Haul Muck.

This work was carried on in very cold mid-winter. Sleighs were used to haul the surplus excavation to the dump. This shewed quite a saving over dump wagons as two teams replaced three on the wagons. Each sleigh took three skips just as they came out of the shaft without dumping. Some thirty extra wooden skips were built at the blacksmith's shop to provide storage at the shafts when the teams were away. At the sidehill dump a large derrick operated by four laborers, picked these skips off the sleigh, swung them over the bank to be tipped and returned them to the

sleigh. In spite of very cold weather, on only one or two days were operations shut down. Progress in two shafts averaged 50 feet per day. The construction of manholes and appurtenances, however, dragged along until late spring.

On the third contract, on Carlton street, the clay was not quite so dependable, and a heading was lost due to seepage, probably from the nearby water main. On this street there already were two sewers and two water mains at this point. This caused a week or ten days' delay, for a shaft had to be sunk here and about twenty feet thus open cut before tunneling could be resumed. On several occasions the roof showed treacherous laminations and roof boards had to be used. Proximity to an old sewer and a ditch over head accounted for this.

As an example of the independence of labor it might be cited that as the sewer became smaller in size the men became more arrogant and when we ceased tunneling on the 48-inch they were paying the same price per foot for labor as they did on the 60-inch when we began.

Open Cut Section

As before mentioned the 42-inch and 36-inch were built in open cut. An Austin trench machine was used to excavate as deep as it would go, varying from the crown to grade as the trench gradually shallowed up. The trench was trimmed by hand labor to the shape and size of the sewer. This necessitated undermining the walls several inches. Good, hard clay submitted to this without a tremor. A Moore machine, consisting of hoist deadman and traveller with cables and buckets all mounted on wide gauge tracks spanning the cut was used to elevate the trimmings and backfill it on the finished work.

Two-ring segment block known as the Robinson block and supplied by the Toronto Pottery Co. were used. These make an excellent looking sewer, the surface being highly glazed. They should be amply strong if care is used to bed each block in a full joint of mortar along the edge and face so as to avoid concentrated loading. We did not get a chance to try them out in wet ground. A short piece of tunnel was built, however, and the only difficulty was a complaint from the bricklayer that the blocks 24 inches long were too heavy to lift into place at the top of the arch where he was crowded for room. Use of blocks 12 inches long should materially remedy this.

Segment Block Construction

The method of construction is much the same as with brick. A bed of dry mortar (1 to 3) was spread along the trimmed subgrade. A template was set and a line strung along the centre. The webbed blocks were then laid in longitudinal courses. It was found preferable to grout these rather than use a trowel. This was followed by laying the inside ring on a bed of mortar, buttering the longitudinal and transverse joints. The crown was built on a drum 12 feet long, the upper middle slats being removable to permit the man laying the block to stand on the invert. The inner blocks were laid on this, a mortar collar joint trowelled over them—care being taken to have the joint between inner and outer blocks at the springer well filled. The webbed blocks were then laid, the drum pulled and inside touched up.

This form of construction proved much more rapid

than brick, using the same gang. Manholes, bell-mouths, etc., were built of brick.

This work was carried on under W. P. Near, city engineer, with the author as resident engineer in charge.

New Concentrator Being Erected

A CONCENTRATOR is being erected by T. A. Walsh & Co., Ltd., engineers, Vancouver, at Bowena Copper Mines, on Bowen Island, Howe Sound, which will have a capacity of 100 tons per day. The machinery is now being installed.

The main feature of the new plant will be the use of salt water for flotation instead of oil. This plan, while not a new method has not yet been tried out in



New concentrator being erected for Bowena Copper Mines on Bowen Island, Howe Sound, B.C.

many mines because their location does not offer the necessary facilities. Where applied the mine must be on or near tidewater. In the case of the Bowena Mine it is only necessary to pipe fresh water for the boilers—the salt water for flotation purposes will be pumped into large tanks located above the concentrator. Tests of this system of flotation, conducted by eminent chemists, have demonstrated a marked gain in efficiency over oil. If this finding is borne out in the operation of the Howe Sound concentrator—and of this no doubt is entertained by the promoters and experts—then we may expect that a number of British Columbia copper properties will be similarly developed by small plants of the kind.

The machinery installed consists of a "grizzly" crusher and fall mill, also a K. & K. flotation machine from Los Angeles; 75 h.p. engine and 125 h.p. boiler. The plant will be in running order by Feb. 15, work having been held back by the U. S. embargo on machinery shipments put on some months ago. The approximate cost of the plant will be \$15,000.

The International Paper Company, N. Y., have completed plans for the development of the Rapides des Forges, Three Rivers, P.Q., in connection with proposed newsprint and pulp mills to be erected by the company at Three Rivers.

The Freezing of a Reservoir Outlet Works

By Gilbert Christie*

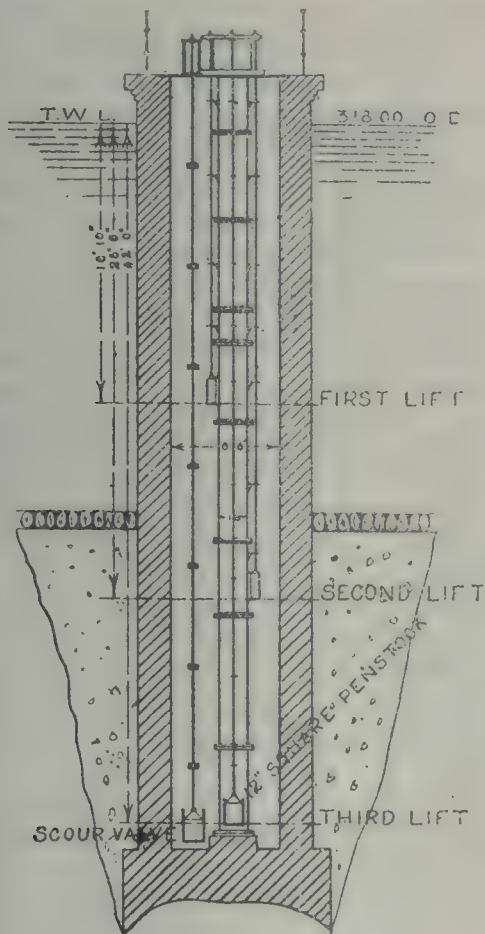
OF the many problems which the waterworks engineer is called upon to solve in the execution of his duties perhaps the least to be expected is that of a complete stoppage of the discharge from a reservoir through the freezing of the outlet works. This occurred at the author's works on January 25, 1917, and again on January 13, 1918. So far as the author can determine, the only previous record of a similar experience was at one of the reservoirs of the Airdrie and Coatbridge waterworks in 1917. In this case the shaft and standpipe were of the modern type with draw-off pipes projecting clear of the shaft

level of the Caaf reservoir being 510 ft. above O.D., and that of the Munnoch reservoir 317.5 ft. above O.D. Both are about the same capacity. Part of the Caaf catchment area is of a peaty description. The usual practice is to run all the Caaf water into and through Munnoch reservoir, and draw the whole supply from Munnoch to the filters in order to keep the quality of the water as constant as possible throughout the whole district. The Caaf water can also be supplied direct to the main pipe from Munnoch reservoir to the filters through a by-pass connected below the Munnoch reservoir. The Munnoch is the oldest reservoir on the works, and was commenced in 1875. The total consumption of water is about $5\frac{1}{4}$ million gallons per day. The figure shows a section of the Munnoch valve-shaft.

At 6 a.m. on January 25, 1917, the filter keeper reported by telephone that water had almost ceased to flow in all the pipes from the reservoir to the filters, and that the clear water tanks were considerably down. Men were despatched to inspect the pipe-tracks, and others, including the author, proceeded to the Munnoch reservoir. On arrival at Munnoch it was found that the keeper was not aware of anything wrong. The men who inspected the tracks reported all right. Inspection of the shaft, however, revealed the fact that air was rushing into the stand-pipe, and the interior of the shaft was evidently empty of water as far down as could be observed for ice. Soft ice was adhering in large quantities to all the inner walls of the shaft, to the protruding parts of the stand-pipe fittings, and also to the copper screen in front of the shaft, where it was about 12 in. in thickness, and formed a curtain completely preventing water from entering the shaft. The two top lift-valves had been open and the subsequent opening of the bottom one made no improvement.

To restore the supply a large proportion was turned through the by-pass pipe from the Caaf reservoir into the outlet pipes immediately below the Munnoch reservoir where it passed through the stand-pipe into the Munnoch reservoir until it released the ice to some extent from the sluice valves and bottom of the screen. The direction of the Caaf water was then altered to pass down the pipes to the filters along with that which could be got through from Munnoch. Men were also told off to remove the ice on the outside of the screen with spades, etc., work which had to be continued until the weather became quiet and a skin of ice formed over the whole surface of the reservoir.

On the evening of January 13, 1918, under similar weather conditions, a recurrence of this phenomenon was reported, and, as before, resulted in a complete stoppage of the supply of water to the filters. Several degrees of frost had been almost continuous for two or three weeks, and a skin of ice was formed over about two-thirds of the area of the reservoir. The remaining part was open water all round the region of the shaft. A strong north-east wind prevailed, keeping the open water much disturbed, and as it was blowing towards the front or screen side of the shaft, it caused the soft drift-ice to cling to the screen. On this occasion the bottom and middle lift-valves had been left open with the object of drawing the water as far as possible from the bottom of the reservoir, where it would be at a



Cross section through outlet works

and with large bell-mouth inlet pipes turned upwards. This would serve to show that the stoppage was not due, as some were inclined to think, to the older type of shaft at the author's works, and as similar conditions may exist elsewhere the author submits the following observations on the probable causes and means of prevention, hoping that the record of his experiences may prove to be of interest and utility to others.

A few particulars relative to the works are first of all necessary to a complete understanding of the case.

The district is supplied from two impounding reservoirs on different gathering grounds, the top water

* Engineer and Manager, Irvine and District Water Board.

slightly higher temperature than at the surface. This precaution, however, again proved valueless as a means of preventing the entire choking of the screen with ice.

In seeking the cause of the obstruction of the screen by ice it is necessary, first of all, to consider the general conditions which obtain during the freezing of the reservoir. The surface, being heavier, sinks, and the warmer water at the bottom rises to take its place. This goes on as long as the surface continues to cool, but when the whole of the water in the reservoir has reached a temperature of 39.2 deg. F. the surface water, if further cooled, becomes lighter and remains on the top, and, should the temperature of the water be reduced to 32 deg. F., a thin layer of ice will be formed over comparatively warm water. This preserves the animal life in the water, and forms a barrier protecting the water underneath from the cold; indeed, were it not for this condition the reservoir would be converted into a mass of solid ice.

The fact that ice may take three different forms has an important bearing on the problem under consideration, and it may therefore be desirable to give a short description of each.

(1) "Surface" ice is the common form which appears on the surface of the water when the temperature of the water is cooled to the freezing point. It appears first near the shore, and gradually extends out as the deeper water is cooled, the entire surface being covered where the temperature of the air has remained below freezing-point for a period sufficient to cool it to just below 32 deg. F. The ice once formed, the thickness increases, mainly through the conduction of heat from the water through the ice. As the conductivity of ice is low, this process is relatively slow, and the thicker the ice sheet the slower the increase in the depth of ice.

(2) "Frazil" ice is the form which appears in running water when the temperature of the water falls below 32 deg. F., and where sheet-ice cannot form owing to the movement of the water. It forms at the surface, and may be made up of small flat plates if the surface is not greatly agitated, but more frequently is in the form of minute needle-shaped crystals, which join together and form a bulky mass, floating lower in the water than ordinary surface ice.

(3) "Ground" ice is ice which is found attached or anchored to the bottom of a river or stream, and results from the cooling of the material at the bottom of the river by radiation and the resultant freezing of the water which comes in contact with surfaces which have been cooled below freezing-point. It will only occur under a clear sky and where there is nothing to interfere with the process of radiation. It will not be formed under a bridge where radiation is interfered with, nor under ice, which also prevents radiation. When the sun's rays strike the masses of ice, earth and stone they are absorbed, and frequently the whole mass will become loosened and float to the surface.

All these forms are of interest to the waterworks engineer, not only as affecting problems arising at the source of supply, but also in the distribution of water. It is also a well-established fact that continued frost over a long period in quiet, anti-cyclonic weather does not endanger the supply of a reservoir.

It can thus scarcely be doubted that the trouble experienced was caused by the formation of ice in a crystalline form throughout the unfrozen area of the reservoir, a process resulting from and greatly accelerated by the low temperature coinciding with the agitation of water by a strong wind. Owing to the consumption of water in the district having enormously increased, the

quantity drawn from the reservoir was more than double that for which the works were originally constructed. This heavy draw through the stand-pipe caused the loose masses of frazil ice near the surface of the water, and of almost equal density with it, to be carried towards the wire screen and valves, and to which it adhered in an irregular manner until there had been built, from the top downwards, an ever-hardening wall sufficient to stop percolation. This will be more readily understood if it is considered that on account of the unusual conditions of the weather the water in the reservoir had fallen to a very low temperature, and on approaching the shaft and going through the screen would be very nearly 32 deg. F. As the temperature of the water was probably lowered still further in the shaft, the formation of frazil ice would be quite uninterrupted, it having been found by experiment that a reduction of 0.01 deg. F. is sufficient to cause the formation of frazil ice.

To find a quite certain means of prevention under such circumstances would be extremely difficult, but no doubt it would be an advantage to reduce the rate of flow under similar circumstances by drawing the water from each reservoir separately. As, however, the trouble was, perhaps primarily, due to the existence of the area of agitated open water round the shaft and the consequent production of frazil ice, the author considers that the early formation of a sheet of surface ice covering the water in the immediate vicinity of the shaft would most probably be an effective protection against the recurrence of the phenomenon. The formation of such a sheet of ice over the disturbed water might be induced by floating light wooden hurdles on its surface. Ice would be readily formed in the comparatively calm water which would exist between the hurdles, and with this barrier once established it is probable that no further trouble would be experienced.

These are the only means of prevention which suggest themselves to the author as at all likely to prove an adequate safeguard against a similar occurrence in the future, and if adopted at the commencement of the cold spell when the conditions are favorable to the formation of frazil ice in large quantities they would, in all probability, secure the desired protection with a minimum of labor and of expense.

Ontario municipalities which have signified their intention of taking advantage of the provincial government's housing scheme are as follows: Windsor, Sudbury, Ottawa, New Toronto, Kitchener, Sault Ste. Marie, St. Catharines, Collingwood, Port Credit and Leaside. Many others are giving the matter very careful consideration.

The big aqueduct which the Hydro-electric Power Commission of Ontario is building at Niagara Falls to carry water from above the falls to the site of the power house formerly owned by the Ontario Power Co., is expected to be completed by the first of March. The aqueduct, which is of wood stave construction, is half a mile in length and 13½ ft. in diameter.

The Regina Builders' Exchange, at their recent annual meeting, elected the following as their officers for the current year: President, E. E. Poole; vice-president, R. J. Lecky; treasurer, Alex. Young; secretary, W. Ross MacKenzie.

Review of Building Activity in Canada

A Nine Year Comparison

DURING the year 1918 there was a slight increase, compared with 1917, in the value of building permits issued in the 35 cities with population of 15,000 or over. The estimated cost of the building work in these cities in 1918, according to the figures supplied by the Department of Labor, was \$36,838,270, as compared with \$33,936,426 in 1917, an increase of \$2,901,844, or 8.56 per cent. In the accompanying table which groups the cities by provinces, increases are shown in all the eight provinces

Estimated Cost of Building Work in the Years 1917-1918, as Indicated by Building Permits Issued in Thirty-five Cities

City	1917	1918	1918 compared with 1917	
			Increase (%)	Decrease (%)
Nova Scotia	\$1,320,647	\$3,295,635	*\$1,974,988	*149.55
Halifax	904,377	2,860,852	* 1,956,475	* 217.00
Sydney	416,270	428,783	* 12,513	* 3.01
New Brunswick ..	870,963	498,748	† 372,215	† 42.74
Moncton	339,713	147,425	† 192,288	† 56.60
St. John	531,250	351,323	† 179,927	† 33.86
Quebec	8,794,149	6,852,354	† 1,941,795	† 22.08
Montreal-Maison-neuve	5,501,918	4,882,873	† 619,045	† 11.25
Quebec	2,459,386	904,375	† 1,555,011	† 63.23
Sherbrooke	254,000	150,920	† 103,080	† 40.58
Three Rivers	423,860	638,975	* 215,115	* 50.75
Westmount	154,985	275,211	* 120,226	* 77.57
Ontario	17,407,571	18,477,012	* 1,069,441	* 6.14
Brantford	287,195	761,500	* 474,305	* 165.15
Fort William	658,445	535,615	† 122,830	† 18.65
Guelph	111,435	83,044	† 28,391	† 25.48
Hamilton	2,746,675	2,472,254	† 274,421	† 9.99
Kingston	150,705	318,943	* 168,238	* 111.63
Kitchener	205,352	226,062	* 20,710	* 10.08
London	837,890	877,660	* 39,770	* 4.75
Ottawa	1,041,017	2,635,612	* 1,594,595	* 153.18
Peterborough	953,503	241,251	† 712,252	† 74.70
Port Arthur	1,345,174	610,527	† 734,647	† 54.61
Stratford	449,036	89,786	† 359,250	† 80.00
St. Catharines	79,875	465,727	* 385,852	* 483.07
St. Thomas	216,338	53,395	† 162,943	† 75.32
Toronto	7,163,556	8,535,331	* 1,371,775	* 19.15
Windsor	1,161,375	570,305	† 591,070	† 50.89
Manitoba	2,392,788	2,140,672	† 252,116	† 10.54
Brandon	180,338	90,022	† 90,316	† 50.08
Winnipeg	2,212,450	2,050,650	† 161,800	† 7.31
Saskatchewan ..	1,994,659	2,177,290	* 882,631	* 68.17
Moose Jaw	295,460	566,575	* 271,115	* 91.76
Regina	416,460	1,006,000	* 589,540	* 141.56
Saskatoon	582,739	604,715	* 21,976	* 3.77
Alberta	\$59,000	1,548,270	* 690,270	* 80.45
Calgary	548,200	1,196,800	* 648,600	* 118.31
Edmonton	309,800	351,470	* 41,670	* 13.45
British Columbia ..	997,649	1,848,289	* 850,640	* 85.26
New Westminster	81,515	108,300	* 26,785	* 32.86
Vancouver	768,255	1,450,229	* 681,974	* 88.77
Victoria	147,879	289,760	* 141,881	* 95.94
Total—35 cities...	\$33,936,426	\$36,838,270	*\$2,901,844	* 8.56

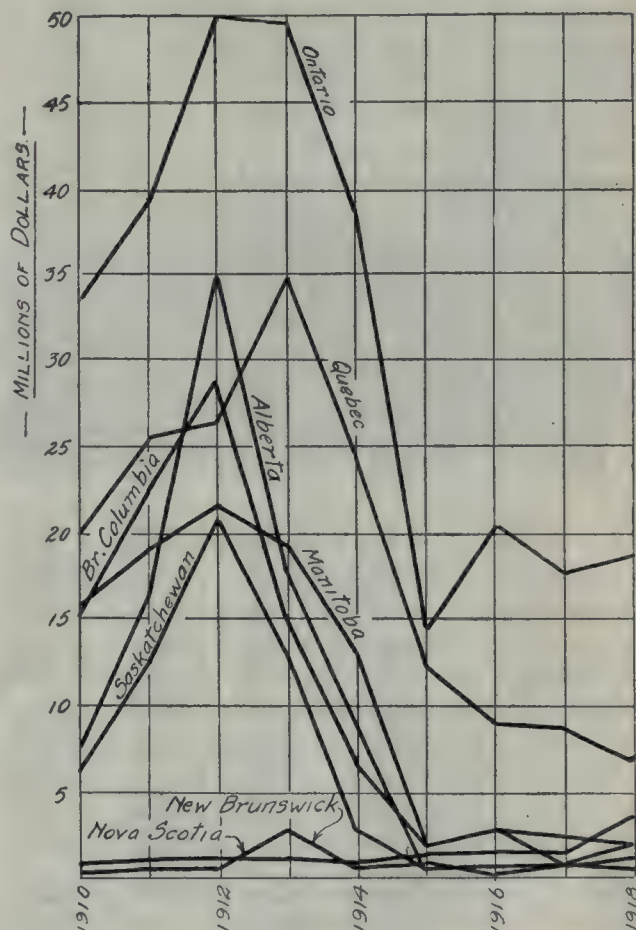
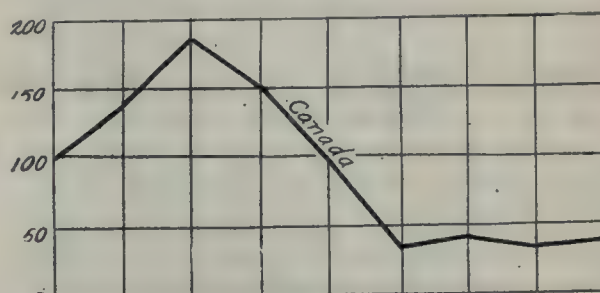
included except New Brunswick, Quebec and Manitoba. The greatest increase, 149 per cent., was shown in Nova Scotia, and substantial increases were also reported in Alberta and British Columbia. Of the larger cities, Halifax, Ottawa and Calgary showed marked increases, Toronto, Vancouver and Victoria also reported increases, and Montreal and Winnipeg reported slight decreases. Of the smaller centres, Brantford, Kingston, St. Catharines, Regina and Moose Jaw recorded gains as compared with the previous year.

An analysis of the figures show that the pre-war building situation has been better maintained in Nova Scotia than in any other province. In the years 1915, 1916, 1917 and 1918 the total for the two Nova Scotia

cities was higher than in any of the previous other five years. In New Brunswick, however, the total for 1918 was less than it has been for any year since 1910. In the province of Quebec there has been a steady decline from the high level of 1913. The yearly percentages of decrease for 1914, 1915, 1916, 1917 and 1918 are approximately 28, 50, 20, 10 and 22 per cent.

Ontario Shows Slight Increase for 1918.

The total for the 14 Ontario cities fell from \$50,000,000 in the record years of 1912 and 1913, to \$18,000,000 in 1918. The lowest level was reached in 1915,



Variation of Building Permit Values shown Graphically for years 1910-18

when there was a falling off of over 60 per cent. from 1914. In 1916 there was an increase of 41 per cent. over 1915, but in 1917 there was a decrease of 14 per cent. over 1916, and in 1918, an increase of only 6 per cent. over 1917. The figures for 1918 show a decrease of 63 per cent. from the record year of 1912, and an increase of 29 per cent. over 1915, when the volume of building permits reached the lowest figure since 1910.

In the four western provinces the highest figure was

reached in 1912 and the lowest figure in Manitoba, Saskatchewan and Alberta in 1915, while in British Columbia the lowest figure was reported in 1917. In Manitoba the amount for 1918 shows a decrease of 113 per cent. over 1912 (the record year) and an increase of 15 per cent. over 1915 (the year building permits reached lowest amount). In Saskatchewan the corresponding decrease and increase amount to 89 per cent. and 279 per cent. In Alberta the decrease is 95 per cent. and the increase over the minimum amount since 1910 is 236 per cent. In British Columbia the decrease from the maximum figure in 1912 is 94 per cent. and the increase over the minimum of 1917 is 85 per cent.

January's Building Permits Less Than Those of Last Year

Activity in the building trades, as indicated by the value of building permits issued in 35 cities, showed a decline during January, 1919, as compared with the preceding month, the total value of building permits falling from \$1,640,724 in December to \$1,096,974 in January, a decrease of \$543,750, or 33.1 per cent. Nova Scotia, New Brunswick and Manitoba reported increases in comparison with the preceding month. As compared with the corresponding month in 1918, there was a decrease of 30.0 per cent., the value for January, 1918, being \$1,568,045. Quebec, Alberta and British Columbia were the only provinces to record declines in this comparison.

Of the larger cites, Winnipeg alone reported increases as compared both with the preceding month and with the same month in 1918. Vancouver showed

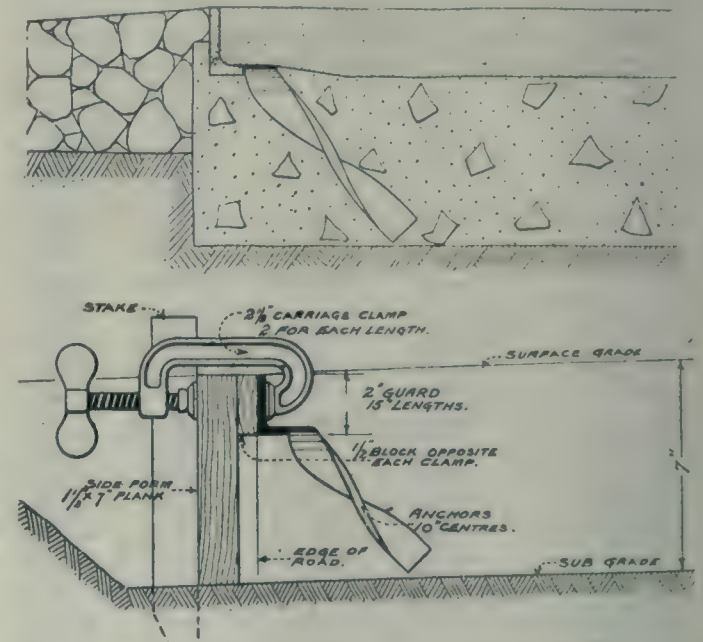
Estimated Cost of Building Work as Indicated by Building Permits Issued in Thirty-five Cities

City	January, 1919	January, 1918	January, 1919, compared with January, 1918.	
			Increase (*) Amount	Decrease (†) Per cent.
Nova Scotia	\$151,450	\$71,280	* \$80,170	* 112.42
Halifax	137,295	62,470	* 74,825	* 119.78
Sydney	14,155	8,810	* 5,345	* 60.67
New Brunswick	9,500	.....	* 9,500	.....
Moncton	9,500	.....	* 9,500	.....
St. John .....	.....	.....	.....	.....
Quebec	84,599	167,782	† 83,183	† 80.48
Montreal-Maisonneuve	60,154	116,110	† 55,956	† 48.19
Quebec	20,095	30,572	† 10,477	† 34.27
Sherbrooke .....	.....	300	* 200	* 66.67
Three Rivers	3,850	19,300	† 15,450	† 80.05
Westmount .....	.....	1,500	.....	.....
Ontario	623,633	612,362	* 11,271	* 1.84
Brantford	2,650	5,245	† 2,595	† 49.48
Fort William	500	80,000	† 79,500	† 99.38
Guelph	2,500	.....	* 2,500	.....
Hamilton	171,450	51,242	* 120,208	* 234.59
Kingston	2,267	5,195	† 2,928	† 56.36
Kitchener	99,600	3,600	* 96,000	* 2,666.67
London	17,530	17,150	* 380	* 2.22
Ottawa	50,350	8,875	* 41,475	* 467.32
Peterborough	190	3,300	† 3,110	† 94.24
Port Arthur	3,511	16,895	† 13,384	† 79.22
Stratford	180	2,945	† 2,765	† 93.89
St. Catharines	17,780	3,035	* 14,745	* 485.83
St. Thomas	3,200	.....	* 3,200	.....
Toronto	225,375	409,965	† 184,590	† 45.03
Windsor	26,550	4,915	* 21,635	* 440.18
Manitoba	93,400	41,100	* 52,300	* 141.85
Brandon .....	.....	.....	.....	.....
Winnipeg	99,400	41,100	* 58,300	* 141.70
Saskatchewan	6,820	5,800	* 1,020	* 17.59
Moose Jaw	800	.....	* 800	.....
Regina	4,100	700	* 3,400	* 485.71
Saskatoon	1,920	5,100	† 3,180	† 62.35
Alberta	22,000	507,400	† 485,400	† 95.69
Calgary	18,000	505,000	† 487,000	† 96.43
Edmonton	4,000	2,400	* 1,600	* 66.67
British Columbia	93,572	162,321	† 68,749	† 38.63
Vancouver	78,197	53,125	* 25,072	* 32.06
Victoria	15,875	107,546	† 91,671	† 85.24
New Westminster	5,500	1,650	* 3,850	* 233.33
Total—35 cities	\$1,096,974	\$1,568,045	†\$471,071	† 30.04

a gain over January of last year, while Montreal and Toronto recorded declines in both comparisons. Of the smaller centres, Halifax and Kitchener both reported increases as compared with December and with January, 1918.

Guards for Protecting Edges of Pavement

THE weakest point of a concrete roadway is at its edges. Difficulty is usually experienced in holding in place the wearing surface and preventing water seeping below the surface. In the construction of concrete door sills or any concrete corner that is likely to be subjected to hard usage it has been the practice to reinforce the exposed corner by building in an angle iron or steel plate to take the



wear. This practice has now been applied to roadway construction, as is shown in the accompanying illustration. The guard, as indicated, consists of a steel angle held in place by anchors buried in the concrete base. These guards may be made in various sizes to meet the requirements in asphalt paving or for street railway paving and headers also for brick or other types of pavements.

The method of installing is also shown in the illustration.

The Quebec Streams Commission has sent out a party of engineers to make preliminary surveys, etc., for a storage reservoir at Lake Mainanack, on the St. Maurice River.

Mr. J. Hawthorn Thwaite, Newcastle, recently introduced in the British Columbia Legislature a bill designed to enforce a 44-hour week for labor in the Province. This bill provides that the government, by Order-in-Council, may fix and define the weekly and daily hours of labor in any class of industry, may fix a maximum and minimum penalty for any breaches or infractions, may make provisions dealing with accidents, the saving and protecting of life and to prevent the destruction of property. The Government may also limit the hours of labor to 44 hours in any one week.

New Sunday School at Fredericton, N. B.

TO further the interests of religious instruction and meet the demand in this direction of the ever-increasing population, it was found necessary to have better and more commodious accommodation, and, for this reason Mr. Donald Fraser of Fredericton, a strong supporter of the Presbyterian Church, expressed a desire before his death that his family should undertake the work of building a new Sunday School as an addition to the present church on York Street.

The building, in its largest dimensions, is 74 ft. 0 in. wide, by 92 ft. 0 in. deep, with a frontage on York Street of only 56 ft. 0 in., as it butts against the cloister wing of the present church at this part. The existing building is faced with rock-faced rubble limestone with plain trim to all openings and cornice, and this pattern had to be followed closely in the new work, the stone for the purpose being obtained by Messrs. Grant & Horne at their extensive quarries, near St. John, N.B., where it was dressed, then forwarded to the job. About 500 square yards in all were required for this building, and this was backed by the foundation concrete walls to four feet above grade and from there up by brickwork.

Brick piers and exterior walls were built on two sides every sixth course being a header course, the bricks used being best grade hard merchantable as manufactured by M. Ryan & Sons, Fredericton.

The lot was excavated to the depth required by the plans and as the material was natural sand, the footings were laid in the position called for and the foundation walls proceeded with, provision being made to take care of the house drainage from the interior of the building by C. I. sewer, 6 in. dia. to 5 ft. 0 in. outside of building, and from there to Main Street sewer by 6 in. salt glazed hub pipe with cement and swab joints. The roof drainage was taken care of separately.

The concrete used was a 1-3-5 mixture, and was used in the footings, exterior foundation walls below grade and above to window sills and forming sills on sides toward George Street, a wash being formed at sills at which height the window and door frames were set. The basement windows were of wood frames set in the concrete wall and were fitted with wire screen guards.

The main entrances are situated on York Street, one at either side of the building and are each fitted with a pair of heavy panelled doors with mullioned church transom lights in leaded glass. In the centre of this elevation are two large three-light windows, having four sashes divided by leaded glass squares, and having limestone mullions with Scotch dressed stone facings, and bevelled arisess, the whole headed by 12 in. continuous string course, running along the face and return stone work. This, in turn, is capped with a deep stepped parapet in the centre of which is placed the Dedication Tablet, the coping being dressed limestone, in keeping with the other mouldings.

Above the doors, which stand back some 18 inches from the building line, are two smaller windows of a design similar to the main windows. In the centre below the main windows are two sets of three windows giving light to the basement. These are fitted with

English sashes and faced with plain, dressed limestone trim.

The height of the entrance porch, which is 9 ft. 6 in. wide, is two steps above the grade line, and 4 ft. 0 in. above this line is the main floor, reached by a flight of eight steps, having plain handrail fitted to wall with malleable cast brackets.

Between the two entrances is a large parlor 26 ft. 8 in. x 18 ft. 6 in., which can be used as a recreation or refreshment room, and at one end of which is partitioned a small kitchen fitted with sink, cupboard, serving window, etc. Behind this room is a 4 ft. passage leading around the main hall, one side of which is open to the class rooms situated at the sides of the building and separated from the main hall on the other side by Accordion folding doors, so that when occasion requires the whole building can be opened up and utilized for lecture or other requirements.



New Sunday School addition to Fredericton, N.B., Presbyterian Church

The large parlor at the main entrance can be closed off into smaller rooms by sliding partitions when so required. At the right entrance hall is situated a Secretary's office fitted with glass windows and counter all around with two opening windows, one towards the entrance and one toward the main hall. Behind this, along the side of the building and at the back of the main hall, are the class rooms for juniors. The floors of these are raised from the level of main floor in three steps towards the back, each room measuring 7 ft. 6 in. x 10 ft. 6 in., and curtained off from one another by folding partitions. A training class room adjoins these smaller rooms facing the main parlor on the other side of the building and is 10 ft. 6 in. x 20 ft. 0 in. heading from the end of the passage. At the farthest corner on George Street is a larger room 23 ft. 7 in. x 23 ft. 2 in. used for beginners, provided with a capacious cupboard and a mothers' room off, provided with toilet arrangements and separated from the training class room by a stairway leading to the gallery.

The main hall is situated directly in the centre of the building and is 33 ft. 6 in. x 53 ft. 0 in. capable of seating from 300 to 400 people. The proscenium or superintendent's platform is 18 ft. 0 in. long by 11 ft. 6

in. wide-with circular front standing 2 ft. 0 in. above the main floor and provided with footlights and recess steps on each side from the main hall. On each side of the stage are built commodious ante rooms, each having two openings to the stage and one from the passage way at back.

Behind the stage is a continuation of the passage way 36 ft. 6 in. wide, off which is the church office library and a porch leading down ten steps to the street on George street. The walls and 4 in. brick partition walls of this floor in the pasasge ways and rooms are plastered throughout with rockwall plaster and wood base. The main stairways are at the entrances and the far side of the hall leading to the basement and to the gallery.

In the basement, below the parlor, on the main floor, is a room of similar dimensions, divided off into three, by folding partitions, and where the Primary department is instructed. A passage way similar to the one above, runs the full width of the building, and



Interior of Sunday School Building, Fredericton, N.B.

at one end is situated a stairway leading to the main floor; adjoining this is a toilet for ladies use. Below the main entrance stairs are lavatories for boys and girls, across the passage is a storage room, entered from a side passage leading to the gymnasium. A cloak room is provided adjoining the physical director's office, which adjoins the observation galleries overlooking the gymnasium. Locker accommodation and shower baths are provided in close proximity to the gymnasium, on one side of the observation galleries, and on the other side is a large kitchen, about 20 ft. 0 in. divided off from the galleries by a 5 ft. 0 in. access passage to the gymnasium. In the kitchen is installed two large ranges and ample cupboard space to take care of provisions for a large number of people. A toilet for men is placed under the main stairway from York street, in one corner of the basement. The rear of the basement is taken up by the heating apparatus and the spacious gymnasium which can be utilized as a dining room when necessary. The dimensions are 58 ft. 0 in. x 37 ft. 0 in., the floor being 3 ft. 3 in. below the general level of the main basement and formed of cinder concrete with birch flooring finish, the walls being rock plastered with cement base and wood trim to doors which are erected flush with the gymnasium walls. Wire screens across the observation galleries protect the onlookers. At the further end of the gymnasium is a 12 in. concrete wall shutting off the boiler room, which is 27 ft. 0 in. wide

by 21 long, divided across the width separating the heating apparatus from the fuel bins.

The chimney projects 24 ft. 0 in. above the eaves having an Octagon shape, 20 in. diameter tile flue lining, surrounded by 10 in. concrete and placed directly in the corner of the building, provided with clean-out door, etc. The lining was carried up past the roof line, and the inside thereafter was plastered, the top being coped with a heavy cement cap.

The floor above the main floor forming the second floor and balcony, is divided in a similar way to that below, the back part in the small class rooms separated by folding partitions for the instruction of the intermediate department boys and girls, and between the main stairways is a large room as below for the adult class. Senior classes occupy the corner above the Beginners' on the main floor, and the choir is delegated to the space above the stage and dressing rooms. The passage or aisle around the hall is duplicated in the balcony above, but is formed in the levels with a step at intervals. This part of the balcony is formed of woodwork sheathed both sides 4 in. plain, Douglas Fir boards lapping each vertical joint forming a series of small panels, the whole capped with neat coping of Douglas Fir and on top of which is erected hard pine pedestals at intervals of six feet, carrying a hard pine wood rail of round setion. All the floors of the passages throughout are of 7/8 in. matched birch, the main floor being "Bay Shore" spruce, the basement and superstructure doors have panels with glass panels where called for and the folding doors, which are 1 3/8 in. thick, operate in bulkheads built up level, where the doors are terraced the height of the upper terrace. All being installed so as to fit closely to the wall when folded. Sidewalls of public halls, vestibule and passages, front of stage, etc., are wainscoted with Douglas Fir sheathing, the same being carried down on wall side of stairs and double faced on the face of stairs and around wall capped with handrail.

A central diffuser is hung from the ceiling over the main hall controlled by closing valves operated by chords.

Above the galleries in the centre of the building, is erected a clerestory 61 ft by 61 feet, panelled off into windows on all four sides. The roof is flat, covered with tar and gravel, Barrett sepcification, and is supported by 4 trusses of 61 feet span, the width of the opening. These trusses are of lattice construction, and for appearance were sheathed on both sides and bottom with Douglas fir narrow sheathing, in keeping with the woodwork trim throughout the building. The portion below and around the clerestory is covered with galvanized "Toncan" metal 1-c thickness for roofing and 1-x for any valleys, gutters or spouting, painted one coat metallic roofing paint on the outside and linseed oil and red lead on the underside.

Fireproof doors are placed throughout where required by the Underwriters and ample access is provided from the church to the new premises.

This is a fine example of what a modern Sunday school building should be, and any architect contemplating the erection of such a building would do well to see this new structure before proceeding further.

The contract was let on the 14th of May and the work completed shortly after the New Year, under the personal supervision of Mr. E. G. Horne, partner in the firm of Messrs Grant & Horne, general contractors and engineers of St. John, N.B., who had the contract.

The Township Council and the Engineer

By Robert M. Lee. O.L.S., D.L.S.

IN dealing with the subject of the relationship between township councillors and their engineers, I will endeavor to point out the duty of the Engineer towards the municipal corporation of the township by whom he is engaged, and also a more ideal attitude of certain councils toward the engineer.

It would be well to note that the difference between individual township councils is probably as great as that between individual engineers, and that in the main, the councillors are men of good, sound judgment, with the welfare of their municipalities at heart. It is therefore the care of the councillors to spend wisely the moneys of their electors.

As the work of the Engineer is confined largely to road construction, bridge building and drainage work in the more rural municipalities, the conclusion drawn here will deal largely with these, and particularly the latter two, and with reference to bridge work, will refer to concrete structures in particular.

It is, I think, generally conceded that it is an economy to have all bridges designed and all drains laid out by a competent engineer. In proof of this, let me cite an instance where a township each year built 3 or 4 bridges, ranging from 20 to 30 feet in span, by the rather questionable method of using plans which contractors had appropriated from work done elsewhere by them. The Councillors and the contractor then endeavored to fit these plans to the bridges to be built. Upon the presentation of a somewhat different condition of site, or possibly it may have been upon the election of a reeve of more careful principle, an engineer was asked to design these bridges. A further most necessary duty was required of him, which was the laying out of the new work. Upon completion of these it was found that \$450 was saved in comparison with the cost, the previous year, of slightly smaller structures, after paying the engineer for his plans, and notwithstanding an increased cost of material.

Particularly if the construction be of reinforced concrete, and incidentally this type is to be preferred where foundations vary, or the haulage of materials is long, any but a competent engineer is unfit to design such a bridge and unless the structure for each separate site is so designed, there can be no certainty as to the finished work.

The work of the engineer, after he has measured up the site and prepared the necessary plans, will consist of preparing specifications, tender forms and forms of agreement, to be signed by the contractor and the municipal corporation which is having the work done. One of the requirements of the agreement will be that a satisfactory bond be given by the contractor, which will be held by the municipality until the satisfactory completion of the work. Particular note will be given to fixing a time limit for the completion of the work, with penalties for neglect, the fixing of prices for all extras or contingencies, the complete understanding as to what quality of materials and proportions thereof shall be used, and the retention of a percentage of the contract price until a written certificate, signed by the Engineer, as to the satisfactory completion of the work is received by the Municipal Council; and that all sheet piling and similar material shall be

furnished by the contractor at his expense. This last clause is of particular note because an uncertainty exists in some municipalities as to who shall pay for such material if it is lost, and cannot be recovered from the work done.

One of the most difficult problems confronting the municipal council is the proper supervision of the work of construction. I have found a very satisfactory manner in which to handle this for the Council to appoint a reliable man who may live near the work and who shall take instructions from the engineer just how to carry out this supervision. I have in mind a man so appointed who is now able to follow almost any plan presented to him and who is now a most valuable asset to this municipality in this regard. It is considered advisable, in addition to this, to have the Engineer visit the work when the grade for the foundation has been reached and as many times thereafter as is convenient and economical.

Many head walls of culverts of different types have failed because of faulty design. The councillors probably considered the work too small or too simple to demand the services of an engineer. A head wall with a uniform thickness of 18 inches or less, and a height of probably 8 or 10 feet above ground, with a road fill to the top of the inner face, has been thought by councillors or concrete men, to be of perfectly good design, with the result that the entire work, in all probability, may be overturned. A crack, in many instances, appears in the centre of the wall, directly above the pipe, on account of premature footing, and the absence of necessary reinforcement. The maxim that whatever is worth doing is worth doing well, most surely applies to the head walls of culverts.

With regard to drainage work, it can readily be seen and understood that where a grade for a closed or open drain is very flat, it is unwise to proceed with work of any considerable size, even though done outside the jurisdiction of the Drainage Acts, without having the work staked and the grade set by a competent engineer. We all know of instances where tile drains have been constructed without these precautions which have had to be taken up and relaid at an expense equal to or greater than the original cost, while the drain in the first instance gave no satisfaction whatever.

The service that an engineer should give the municipal corporation by whom he is employed is probably well understood by the engineering profession and also by most councillors. Thorough, conscientious and careful work is always necessary, and in nearly every case the engineer and not his assistant must go over practically all the work in hand. The responsibility involved and the judgment and care necessary in making a single drainage assessment, where many owners are interested, and in designing the majority of bridge work, is in excess of the remuneration derived. It might be well to note that in comparison with the charges of professional men of other ranks, those of the engineer are very much less. If the councillors realize that the Engineer is vitally interested in the work he is doing for them and that the responsibility is always great, the help he will get from them will in some measure compensate him.

Where an engineer is frequently employed by a municipality the relationship between the councillors and himself is usually pleasant and mutually helpful. Where the services of an engineer are largely avoided, the municipality, as well as the engineer, is the loser,

and if this attitude were maintained by every municipality, it would be impossible for the engineer to maintain his private practice, which should, at least, be a benefit to the communities in which he works.

For the municipalities, therefore, who endeavor to avoid engaging an engineer, even when they know that his services are really required, I would point to the conclusion above drawn, and would ask that in future they co-operate with the engineer in their locality, giving him such work as they may have, that his services to all the municipalities by which he is employed may be more uniformly distributed, resulting in greater efficiency at a somewhat lower cost to the municipalities in question.

Manitoba Good Roads Assoc'n Annual

The Manitoba Good Roads' Association, at their 10th annual meeting, held in Winnipeg, recently, re-elected, by acclamation, President Henderson, Vice-president Waugh, and Secretary-Treasurer G. F. Bentley, who have held office continuously since the association was formed. Among important resolutions passed were the following:

That the association place on record its approval of the immediate improvement of the main highway from Winnipeg to Emerson, known as that portion of the Jefferson highway in Manitoba.

That the association, having learned with the deepest sorrow of the illness of Hon. T. H. Johnson, who had ever shown a hearty interest in the question of good roads in the province, extend to Mr. Johnson their fullest sympathy and their hope for his early and complete recovery.

A motion endorsing the resolution passed at the last executive meeting of the association that, if Dominion subsidies for the purpose of building good roads are to be granted, they should be granted to the provinces, to be expended by provincial authorities.

A motion that, owing to the scarcity of gravel and other road-building material in many parts of the province, the association suggests that the provincial government, at as early a date as possible, conduct experiments in road-building materials for the benefit of the municipalities.

The association endorsed the recommendations of the Union of Manitoba Municipalities in reference to the provincial government building and maintaining a system of trunk roads throughout Manitoba, and also the union's resolution in regard to taking up the matter of freight rates for road building materials with the different railway companies and the appointment of representatives to act with the executive of the Union in this connection. The province's resources in road building materials formed another topic of discussion, and it was decided to request the Minister of the Interior to fulfill his promise to install a rock crusher at the Stony Mountain penitentiary to supply crushed stone for road building.

A committee consisting of the president, Reeve Henderson, and Messrs. Tallman, Emmett and Button was appointed to take up with the Manitoba government the question of the rules governing the provincial road-dragging competition, with a view to having them consider the amendments proposed by the association.

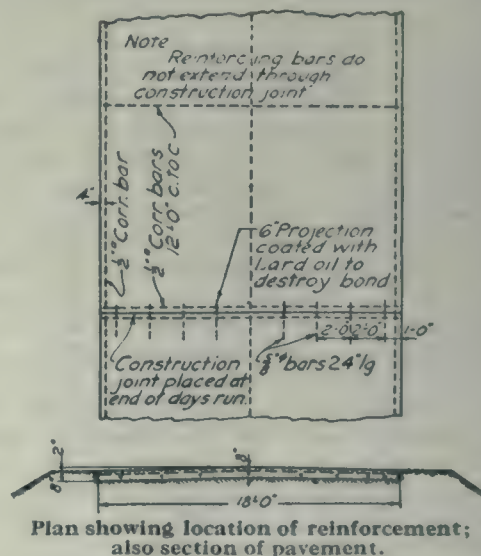
Reeve Good, of Rockwood, and Reeve Ames, of West St. Paul, were appointed representatives of the Good Roads Association to act with the executive of

the Union of Manitoba Municipalities in taking up with the railway companies the matter of freight rates on road-building materials, and each municipality, and the members of the association be notified of the motion in this matter, so that they can co-operate, if they so desire.

Circumferential Reinforcement Used on Highway

A SECTION of roadway amounting to 2,500 feet has just been completed in Iowa, where an 8-inch concrete pavement, 18 feet in width, with circumferential reinforcement, was adopted. No expansion joints were placed anywhere in the pavements. A construction joint was formed at the end of each day's run by finishing concrete to a wood header cut to the crown of the pavement. $\frac{5}{8}$ -inch round rods 24 inches long were inserted through holes in the header and allowed to project 6 inches from the end of the slab. These were placed 3 inches from the bottom of the slab and 24 inches apart and formed a key between adjacent slabs. Before work was resumed the following day the header was removed and the projecting ends of the bars were given a coat of hard oil to break the bond with concrete and permit the bars to slip.

Circumferential reinforcement was used in this work, (see illustration), one-half inch square bars being employed throughout. Longitudinal bars were



placed 4 inches from each edge of the slab and along the centre line. Transverse bars were placed 12 feet apart. Reinforcement was placed 3 inches below the top of the slab and was supported on wooden stakes driven into the subgrade. Concrete was struck off with a steel-shod template and finished with roller and belt. On account of lack of the usual amount of coarse aggregate, some difficulty was experienced in operating the roller over the freshly placed concrete, but by allowing the concrete to stand for a time after placing, very satisfactory results were finally secured. The concrete was rolled twice, the roller being advanced in such a manner that all portions of the surface were rolled four times in each operation. The surface was belted two or three times after each rolling. In a few cases, where necessary to obtain a satisfactory surface, a third rolling and belting were given.

Highway Cost Keeping*

WITH regard to uniformity of costs it may be observed that at the present time, in Canada, it is almost impossible to secure reliable information as to the cost of constructing different kinds of roads with complete details as to the separate cost of materials, labor, etc., entering into the construction. Consequently, it is difficult for the different municipalities to prepare anything like reliable estimates of the proper, necessary and reasonable costs of improvement and of maintenance, and therefore of the amount of money that should be provided for the same. In some of the States this difficulty has been met by the creation of a cost-accounting system in connection with their state highway organization to collect complete details of the expenditure relating to any kind of road improvements and also with regard to costs of maintenance of roads and bridges. This information has been of very great



Mr. A. W. ("Good Roads") Campbell,
Dominion Highway Commissioner

value to them in making reliable estimates; further, it serves as a check on expenditures in progress whether under contract or by day labor.

Where construction or maintenance work is being done at the joint expense of governments or municipalities, it is highly desirable that the methods adopted, materials used, and labor employed be of an acceptable quality, that the prices be fair and reasonable and that the general management of such work be business-like and efficient.

To this end, a proper cost-accounting system should be instituted by the highway department of each of the provinces in order that reliable data of actual detailed costs may be supplied to the federal government's department. This data would also be available to the provincial highways departments through the federal department to serve as a guide in the preparation of the estimates, and in governing their expenditure during the progress of the work. The information thus acquired should be kept in a manner that will serve to determine what types of

highways under different conditions have proved to be most economical.

Perhaps the chief benefit to the various provincial highway departments in maintaining a proper cost-accounting system would be the better resulting organization in managing and carrying out day labor work in hand, or to be undertaken at any point, in fact the general effect it would have upon the whole organization. A knowledge that a check is being placed on every article of material that enters into the work and on the amount and costs of labor required to perform a certain service and that a comparison of costs and results is being made with other similar work will undoubtedly have a powerful influence in making those directly in charge more diligent in their work and more careful in the selection and quality of materials purchased, prices paid, efficiency of labor services employed and of the machinery and plant handled by them.

In a recent address, Mr. T. W. McGarry, Provincial Treasurer, stated that the Ontario Government proposed to spend large sums of money this year to relieve unemployment, in the construction of highways and buildings. Public buildings costing \$2,200,000 would be erected; \$5,000,000 would be expended on highways; \$11,000,000 would be for relieving the housing problem, \$5,000,000 of it to be spent this year; \$1,000,000 would be spent on the construction of roads and bridges in Northern Ontario, and \$1,000,000 for extensions and improvements to the T. & N. O., a total of \$14,000,000.

While it had been intended that under the housing scheme a dwelling was to cost not more than \$2,500 and the lot \$500, or a total of \$3,000, this had been changed, Mr. McGarry said. The Municipal Director will be permitted to allow the erection of a house not exceeding a cost of \$3,000, and the house and lot not exceeding \$3,600. Should a private person desire to erect his own home on land owned by the Municipal Housing Commission he could do so, provided he put up ten per cent. of the value of the house and lot. No cash payment and no security would be required where a returned soldier wanted to erect his own house.

Further particulars are available as to the Bill before the Quebec Legislature, asking that the contractors for the LaSalle bridge be reimbursed the monies spent on the job. Originally the Bill contained the names of Messrs. T. O'Sullivan, A. Pion and F. A. Grothe, but the former name has been struck out. Mr. O'Sullivan failed to complete the work, which was then handed over to Messrs. Pion & Grothe. They also did not complete the contract, with the result that the city undertook the work themselves. Messrs. Pion & Grothe allege that the contract was held up owing to the war, the increase in wages and in the cost of materials. It is asked that a board of arbitration be appointed to fix the value of the work done by the petitioners, and also of the plant and materials which the city appropriated, and that the deposit be returned. In considering the value of the work no account is to be taken of the profits which the petitioners would have realized or might be entitled to. The arbitrators are not to be bound by the rules of evidence and are to act as "amicable compounders."

* From address by A. W. Campbell, C. E., before Eastern Ontario Good Roads Association.

Mainly Constructional

East and West—From Coast to Coast

The Board of Trade of Welland, Ont., is agitating for a new union station in that town.

The extension of the electric light and power system at Parry Sound, Ont., is proposed.

A new court house will be built in Yorkton, Sask., this year by the Provincial Department of Public Works.

The Ingersoll File Co., Limited, has been incorporated with a capital of \$500,000, head office in Ingersoll, Ont.

The Matachewan-Rand Gold Mines, Limited, has been incorporated with a capital of \$3,000,000, head office in Toronto.

The Frontenac Graphite Mining Co., Limited, has been incorporated with a capital of \$40,000, head office in Toronto.

The Sheffield Molybdenite Mining Co., Limited, has been incorporated with a capital of \$1,000,000, head office at Ottawa.

The Honor-Kirkland Gold Mines, Limited, has been incorporated with a capital of \$2,000,000, head office at Haileybury, Ont.

The International Machine & Manufacturing Co., Limited, has been incorporated with a capital of \$150,000, head office in Toronto.

Mr. H. Kearns managing director of B. & S. H. Thompson & Co. Ltd. builders' supplies, Montreal, is on a business trip to Europe.

A by-law has been passed in the city of Ottawa providing for the construction of a \$150,000 bridge over Rideau Canal at Somerset Street.

The ratepayers of Oakville, Ont., are to vote on by-laws to build a new school, a fire hall, and to macadamize the principal streets of the town.

Reports are being circulated that the construction of a million dollar bridge across the St. John River, at Fredericton, N. B., is contemplated.

A housing scheme is being put in operation by the city of Outremont, P. Q., the object being to erect self-contained cottages for private purchase.

It is reported that the Government proposes to take over the Glace Bay harbor from the Dominion Coal Co., and will make extensive improvements.

The L'Air Liquide Societe has taken out a permit for the erection of a factory in London, Ont. Harman & Son Co., of Toronto, have the contract.

A deputation from Brockville, Ont., recently waited on Hon. Dr. Cody, Minister of Education, to request that a technical school be established there.

The cathedral of St. Francis-Xavier de Chicoutin, in Quebec, which was burnt down recently for the second time in six years, is planned to be rebuilt.

A deputation from Kirkland Lake visited Toronto recently to urge upon the Provincial Government the need for a railway to that camp. The distance is about six miles.

Municipalities along the Niagara frontier are organizing to promote a project for the construction of a bridge across the river at the Buffalo end, to accommodate vehicular traffic.

It is understood that plans for the Fraser Memorial hospital, to be built in Fredericton, N. B., have been completed and that work on its construction will be started shortly.

The city council of Regina, Sask., is asked for an expenditure on the exhibition grounds totalling \$94,000. The largest item is a livestock arena on the site of the old arena, to cost \$85,000.

The city engineer of Guelph, Ont., is engaged in the formation of plans for the improvement of the sewage disposal plant. The Imhoff and activated sludge systems are to receive consideration.

A proposal is being discussed in Ottawa that the city take over the assets of the Protestant General and St. Luke's hospitals and erect one large hospital which would be entirely a civic institution.

Construction of the War Memorial museum for the province of Saskatchewan, which is to be built in the parliament building grounds in Regina, will be commenced this year. The initial vote for starting the building is \$100,000.

The Shinn Manufacturing Co. of Canada, Limited, has been incorporated with a capital of \$50,000, head office at Guelph, Ont. The firm is authorized to manufacture and deal in all kinds of metals, wire, wire nails, wire cables, etc.

Toronto Brick, Limited, has been incorporated with a capital of \$400,000, head office in Toronto. The firm is authorized to carry on the business of manufacturers of and dealers in brick of all kinds, terra cotta, tile, drain and sewer pipes, etc.

The U. S. Senate has passed a measure authorizing the International Joint Commission to investigate the advisability of an ocean-going ship waterway to connect the St. Lawrence River and the Great Lakes by enlarging the Welland Canal.

A deputation from the Brockville-Cornwall districts recently visited the Parliament Buildings in Toronto to urge upon the government the advisability of constructing a highway between Brockville and Cornwall at the earliest possible date.

The Dominion Government has given a Port Arthur deputation assurance that harbor work at that city would be pushed this year. Another important undertaking proposed in that district is a 250-ton paper mill, which is expected to involve approximately \$9,000,000.

The Ontario Safety League, Royal Bank Building, Toronto, have issued their fifth annual report, being a brief statement of the fire and accident prevention campaign conducted during the year 1918. The booklet also contains a preliminary report of the Canadian National Safety League, Inc.

The construction of a bridge over the South Saskatchewan River is being discussed by the Provincial Government and the question of cost is to be very carefully gone into. The use of pontoon bridges as a temporary expedient has been suggested, and the feasibility of this scheme is also being investigated.

The city of Brantford, Ont., proposes a construction programme involving an expenditure of \$185,000, including sewers, but not walks. New pavements will be laid on Oxford, Murray West and Albion Streets. The new county registry building will be erected this year, after postponement because of the war.

An additional storey to the east wing of the provincial Parliament Buildings, in Toronto, or additional storeys on the new north wing, is to be provided for by appropriations to be brought before the Legislature at the approaching session. This is made necessary through overcrowding. No decision has yet been reached between the two proposals.

The city of Galt, Ont., contemplates the paving of West Main St., Water St., Concession St. to G. T. R. tracks, Wel-

lington St. from Main to Bickhon, and Queen's Square, and has notified the telephone and gas companies and the public utilities commission that it is desired that they do all underground work necessary on these streets.

A bill has been introduced in the New York Legislature in connection with the building of a new bridge over the Niagara River between Bridgeburg and Buffalo. The Dominion Government will be asked to co-operate with the Washington Government, and failing their assistance, efforts will be made to have Ontario and New York State put up the money.

Hon. P. J. Veniot, Minister of Public Works for New Brunswick, has awarded the contract for rebuilding the Salmon River Mouth Bridge to Concrete Builders, Ltd., of Fredericton, at approximately \$35,000, and contract for rebuilding the Digdeguash River Mouth Bridge, parish of St. Patrick, Charlotte county, to Smith & Marrithew, of the same city, the price being about \$14,000.

At a recent public meeting in Winnipeg, Man., called to discuss the housing situation, the following resolution was adopted: "Be it resolved that this meeting of citizens do hereby express itself in favor of accepting the proportion of the amount offered by the Federal Government to which the city of Winnipeg is entitled for the purpose of housing and matters connected thereto.

Reviewing the work of his department in the Legislature, Hon. Geo. A. Grierson, Minister of Public Works for Manitoba, stated recently that in actual construction work the amount expended on the new parliament buildings up to the present time was \$4,373,581, and that an additional \$1,534,769 would be required, so that the expenditure would finally reach a total of approximately \$6,000,000.

The work of tearing down elevator "B," part of the C. N. R. elevator, at Port Arthur, Ont., has been commenced by the bridge and building department of the Canadian National Railways, and a new working house will be erected, in which modern working machinery will be installed. Elevator "B" will be rebuilt of concrete, and it is possible, also, that elevator "A" will also be torn down and rebuilt.

Among important works which will probably be undertaken this year by the Ontario Government are: the erection of two new buildings for acute patients at the Whitby hospital, to cost over a quarter of a million; two new buildings for patients at the Provincial hospital for epileptics; new buildings for Mimico asylum; new building for Orillia hospital for the feeble-minded; addition to the infirmary of the London asylum, to cost about \$100,000.

The Council of the Township of York, at their meeting held on Monday, February 17th, instructed their engineer, Mr. Frank Barber, and his associate, Mr. Wynne-Roberts, of 40 Jarvis St., Toronto, to prepare preliminary sewerage schemes for the urban portion of the township. These portions include East Toronto, Todmorden, Woodbine Heights, Oakwood, Fairbank, Silverthorne, Runnymede, Swansea, Cedar Vale, Mount Dennis, Lambton Mills, etc.

A deputation representing Leeds and Grenville counties recently waited on Mr. W. A. McLean, Deputy Minister of Highways for Ontario, to urge the early commencement of construction on the section of the Provincial Highway between Kingston and Cornwall. Mr. McLean explained that it is the government's intention to proceed with construction all along the line as quickly as possible and, that at present operations are being carried on on the Ottawa-Prescott link.

The housing committee, consisting of Commissioners Forman, Harris, Bradshaw and Pearce, and Dr. Hastings, which was appointed to report on the situation in Toronto,

has recommended the selection of the following prominent citizens to form a permanent Honorary Housing Commission: Sir John C. Eaton, F. A. Rolph, of Rolph, Clark, Stone, Ltd.; J. Allan Ross, of the Wm. Wrigley, Ltd.; H. H. Williams, realty agent; and Sir James Woods, of the Gordon, McKay Company.

The U. S. Fuel Administration has issued a revised second edition of "Fuel Facts." The first edition of this publication, issued in August, 1918, was compiled to supply in concrete and definite form the answers to questions propounded in letters written from all parts of the country calling for information on fuel affairs and concerning the methods of fuel control. The present edition was issued to meet requests still pouring in. Much information of interest to fuel consumers is given in this booklet, in concise form.

The tenders for the construction of the concrete conduit necessary to increase the supply of water from the Montreal aqueduct by 20,000,000 gallons daily, are as follows: The Laurin & Leitch Engineering and Construction Company, Limited, \$58,000; John Quinlan & Company, \$62,000; The Atlas Construction Company, Limited, \$53,300; The Standard Construction Company, \$60,000; T. Lessard & Sons, \$57,400; Quinlan & Robertson, Limited, \$68,232; E. T. Verbanise, \$41,900.

The International Paper Co., N. Y., have completed plans for the development of the Rapides des Forges. Three Rivers, P.Q., in connection with proposed newsprint and pulp mills to be erected by the company at Three Rivers. The plan of the Hydro-electric development includes seven units each of 7,500 h.p., part of the power being available for the purposes of other manufacturers. The directors of the company have not yet come to a final decision as to the carrying out of the scheme.

The estimates passed by the property committee of the Toronto Board of Education provide for the following work: new school on Rose Avenue, to cost \$145,000; 17-room addition to Keele Street school, \$130,000; addition to Wilkinson and Kitchener schools, \$90,000 each; Norway and Duke of Connaught, \$45,000 each; Bedford Park and Eary Grey, \$50,000 each; to relieve Brown, Hillcrest, Ogden and Grant Street schools, \$140,000; Dewson Street, \$70,000; Parkdale, \$60,000; John Ross Robertson, \$30,000; and Carleton school, \$25,000.

Mayor Duncan, of Peterboro, Ont., has received a communication from Hon. Dr. J. D. Reid, Minister of Railways and Canals, stating that he would recommend that the Government pay \$50,000 towards the construction of the proposed Hunter Street bridge, crossing the Otonabee River, of which the estimated cost is \$350,000. The Minister stipulates that this amount will be paid by the Government in lieu of constructing a swing bridge, the Government to be relieved of any responsibility in connection with the construction of the new bridge or any future maintenance.

The extension of the high pressure system in Toronto, for which provision is made in the draft estimates of the works department, would extend the system to cover an area bounded by the waterfront, Spadina, Agnes and Sherbourne Streets. At present the boundaries are, roughly, Simcoe, Queen and Jarvis Streets, extending south to the waterfront at some points. The whole high pressure system is now fed by a single main on Lake Street, and the estimates provide for a new feeder under the railway tracks at John Street, where the feeders of the general waterworks system were recently duplicated.

The architect's report on the Manitoba Parliament Building, submitted to the Legislature, shows that the whole of the external walls are complete and porticos and pediments set. The whole of the internal stone work is set, with the exception of the balustrades, all steel work in place with the

exception of the outer dome ribs, and the floor below and about three-quarters of the marble contract are executed. Heating, ventilating, plumbing, etc., are 75 cent. complete, electrical work 35 per cent., with 50 per cent. of panels and switchboards. The construction has been carried on as rapidly as the shortage of skilled mechanics would allow, and the dome is up 132 feet.

A report on Irrigation Surveys and Inspections, in 1917-18 has been issued by the Department of the Interior, Ottawa. It contains the report of the Superintendent of Irrigation, Mr. E. F. Drake, which deals with the general development of irrigation, hydrometric surveys, water supply investigations, alkali investigations and drainage, and reference is also made to the International Waterways Treaty in connection with the St. Mary-Milk River case. Mr. Drake points out that little development has been carried out in connection with irrigation, the high cost of labor and material having discouraged construction work. Stream measurement work has continued as in former years, and the Department has been active in the investigation of sources of water supply in the West, 288 wells and 54 other sources having been inspected during 1917. The report of Mr. F. H. Peters, Commissioner of Irrigation and Chief Engineer, on "Irrigation and Canadian Irrigation surveys," is also included.

GOOD ROADS ACTIVITIES

The City of London, Ont., acting on the advice of Corporation Counsel Meredith, K.C., is refusing to pay its 40 per cent. share of \$8,000 for suburban road maintenance, an account for which has been rendered by the county of Middlesex. The county officials claim to be acting under the terms of provincial law, while the city bases its objections on the grounds that it cannot be charge for the upkeep of suburban roads when no new roads have been built.

At the Ottawa convention of the Engineering Institute of Canada, Mr. C. A. Magrath, Dominion Fuel Controller, urged the establishment of a revenue-producing tourist road in Eastern Canada. He said such a road should be built up the Gateineau Valley, westward to Pembroke, and thence through Algonquin Park, to Toronto.

The Manitoba Good Roads' Board reports that fifty municipalities have taken advantage of the Good Roads' Act; in 39 work has been done in connection with market road systems and 11 have done work in bridge construction only. In 14 municipalities debentures have been issued and a comprehensive system of road building proceeded with. Last year the total mileage of roads on which work was carried out was 213 miles of earth, 79 of gravel and about half a mile of pavement. The total mileage of good roads constructed to date is 809.79.

The city council of Fredericton N.B., has passed a motion approving a policy of constructing and maintaining permanent streets and sidewalks with an expenditure limited to the sum of \$200,000, extending over a period of not more than five years, including the present year 1919, to be financed by the issue of 15-year serial bonds or debentures.

Victoria county, Ont., will spend not less than \$70,000 for good roads' purposes, plus the government subsidy. A steam roller, stone crusher and several road drags are to be bought.

The county of Renfrew, Ont., has appropriated \$20,000 for good roads' purposes this year.

Victoria county, Ont., will ask the government to designate the road between Lindsay and Bobcaygeon as a provincial-county road, and the road from Fenelon Falls to Bobcaygeon a county road.

The council of Simcoe county, Ont., have appropriated \$150,000 for highway work for the current year. The de-

cision as to the distribution of this amount is left over to the June session. Last year the total good roads' expenditure was \$78,866. Of this amount \$34,325 was used for maintenance and repairs, and \$18,156 for bridge construction.

The council of Wellington county, Ont., has decided to spend \$25,000 on Provincial county road, No. 13, and will spend from \$75 to \$100 per mile on other county roads which are in most need of repairs. The Council has also decided to join the Ontario Good Roads' Association and will send delegates to the Association's convention, and to the Conference of County Road Superintendents.

Hon. S. J. Latta, Minister of Highway for Saskatchewan, announces that experiments in the construction of permanent highways capable of carrying heavy motor trucks, are to be conducted at one or two points in the province during the coming summer. The purpose of these roads is to provide adequate facilities for those communities which are yet a long-distance from the railway. With this object in view the Highways Department is already engaged in making a complete survey of all the gravel deposits in the province.

A deputation representing all the mayors and councils of the municipalities, from St. Lambert to Dundee, along the south shore of the St. Lawrence River, waited on Sir Lomer Gouin, the Quebec Premier, recently, to ask the assistance of the government in the building of a highway along the bank of the river between these two places, to connect up with the state roads at Fort Covington, and other parts of New York State, and thus provide an additional means for New York tourists to visit the province, at the same time enabling the agriculturists of the district, tapped by the highway, to have better means of inter-communication, and enable them to get their produce to market with greater ease.

Lanark County, Ont., plans to spend close to \$100,000 on highway work this year, and a by-law to raise this amount was passed at a recent meeting of the council. The estimates for the year are as follows: Construction, \$30,500; Ferguson Falls Bridge, \$20,000; maintenance, \$24,000; machinery, \$7,250; other equipment, \$1,750; culverts, \$2,500. The contract for the Ferguson Falls bridge is to be carried out by the Ontario Bridge Co.

The first work in connection with the new provincial highway from Toronto to Windsor has been commenced by Mr. R. S. Code and his staff, who are surveying the route between Windsor and Ingersoll.

A by-law has been passed in Wellington county, Ont., to raise \$25,000 for expenditure on provincial county road, No. 13.

The council of Carleton county, Ont., has passed a by-law providing for an outlay of \$40,000 on good roads' work this year.

Obituary

Mr. George Edward Drummond, president of Drummond, McCall & Co., Ltd., Montreal, died in London on Feb. 17, aged 61. With Mr. J. T. McCall he established the firm which bears their name which at one time were the largest iron and steel importers in Canada; later they became extensive manufacturers.

Mr. W. R. J. Hughes, of the plumbing firm of J. W. Hughes & Son, Montreal, died suddenly while curling in a match for the International Gordon medal. Mr. Hughes was a member of the Montreal Association of Building & Construction Industries, and was on the committee appointed to consider the building by-laws of Westmount, particularly in relation to plumbing and heating.

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Standard Cost Accounting for Contractor

IT is idle to suppose that the building and construction industry can be built up successfully without guidance and help, and this assistance can best be secured through co-operation.

It will be frankly admitted that, while many firms have fairly satisfactory methods for arriving at the cost in labor and materials making up their various contracts, the allocation of working and overhead expenses to these main items is dealt with in a variety of ways. It would be beneficial in many ways if greater uniformity could be secured in this direction.

Practically every contractor recognizes the necessity of belonging to his trade organization, and it is so obviously the duty of an efficient trades' organization to establish and maintain a proper standard of value for the product of its members, that this is primarily a question to be discussed in these associations.

A good plan would seem to be to select a small committee consisting of men who have the reputation

of knowing how to handle figures and have ideas on office management, and also to find a few accountants who have had practical experience in costing matters in construction work. They would be asked to table details of the schemes used in their own works, and in a very short time, it would be found possible to evolve from all the data available a model system embodying the best features of the schemes in operation.

With a standard scheme drafted, it could be thoroughly discussed in a general meeting and care should be taken to have it explained by some one capable of dealing with questions of a practical character. When the main outlines of a standard scheme are accepted, there will still remain the real difficulty of either modifying or completely altering the costing arrangements now in force in many offices so as to conform to it.

This, however, is not an insuperable difficulty, provided it can be shown that the standard system agreed upon would not only render it easier to arrive at a common standard of cost and therefore of charge, but would be more useful than the majority of existing costing arrangements in focusing results more clearly, and be helpful to the management in showing where waste in labour and material might be eliminated. Special arrangements might be made for teaching costing clerks the principles of accurate costing and how to use approved methods.

Amended Building Codes are Cost Reducers

FOR some time past Mr. W. W. Pearse, city architect of Toronto, has been reviewing the building by-laws of the city with the idea of relieving the unnecessary severity wherever possible and bringing the code generally up to date.

An important change recently passed by the council is the allowable safe load required in the floor carrying capacity of dwellings. Heretofore this has been fixed at a live load carrying capacity of 50 pounds per square foot. The amendment calls for a uniform safe load capacity of 40 pounds per square foot.

This is a step in the right direction, and the change comes at a most opportune time, when everyone is interested in the reduction of building and construction costs.

Toronto Feels the Scarcity of Houses

THE newly organized Civic Housing Committee proposes to build from one hundred to three hundred houses, and while a few hundred more will possibly be built by private enterprise the majority of these will likely be outside the industrial class in price.

Dr. Hastings, Toronto's Medical Officer of Health, who is in a position to know the condition of the city better than, possibly, anyone else, states that there is an immediate need for five thousand houses. If this is the case, and no doubt it is, we can expect little relief from the building programme of the Civic Housing Committee.

We may expect an increase in population in Toronto of upwards of fifty thousand during 1919 and unless an exceedingly active building campaign is started immediately, conditions are going to be such as to develop a more serious problem than obtains at present.

Instead of improving our slum districts, the con-

gestion is going to be greater and the housing problem increasingly difficult of solution.

One of the chief difficulties prevailing at present is the scarcity of and exceedingly high rentals asked for, workmen's houses. The Civic Housing Committee contemplates the erection of houses for sale only and while this will bring some relief, the situation for the renter is serious. Recently a Toronto workman was asked a rental of \$38 a month for a jerry-built, six-roomed house. Rents such as this make it necessary for families to double up and thus add to the congestion of the city, which, in time, is likely to develop other slum districts.

It appears to be quite evident that the plans adopted by the Civic Housing Committee are inadequate to meet the situation and if a solution is to be hoped for, a much more comprehensive scheme will have to be worked out.

Building Operations Have Permanent Value

SHORTAGE of building is indicated by high rents, and an increasing demand for renting property. While the increase in building cost is considerable, it is in many cases not as great as that of other commodities and with the attention now being given to the various housing schemes, there should be considerable building activity this year.

Building operations do not consume money. It is simply passed from one hand to another, remaining in the national banking system, yet leaving in its wake, when so employed, permanent wealth in the shape of public highways, waterpowers, railways, factories, mills, warehouses and homes. These accomplishments are true monuments to the earning power of society.

Federal Building for Toronto a Certainty

ACCORDING to the recent announcement of Hon. F. B. Carvell, Minister of Public Works, preliminary work in connection with the erection of a new federal building in Toronto will be commenced immediately. This building, which will probably cost over \$2,000,000, will occupy the site of the present Custom House on Front Street together with the vacant land to the west towards Bay St., practically covering the whole block. It will have a frontage of 500 ft. and will be five storeys in height. All Government offices in the city, with the exception of the Post Office, will be located in it. As the first step in the work, the Custom House will be torn down, and when the excavation of the site is being carried on, it is proposed to get the ground plans ready. After these are completed, tenders will be called for the foundation, and during its construction bids will be received for the main building. In this way things will be kept moving from the start.

Ontario Housing Bill is Taking Shape

THE Ontario Housing Bill was given its first reading in the Legislature last week. Sir William Hearst, in introducing the measure, pointed out that it was desirable to have it put through as soon as possible, in order that the municipalities might take advantage of it. He explained that no profit was to be made by the municipalities in loaning the money to the individual or to the housing companies. In cities of over 100,000, the bill provides that a commission of five, not members of the council, may

be appointed to carry out its provisions. Sudbury was the first place to pass the necessary by-law to comply with the Act, and Windsor and Sandwich have since taken similar action. About twenty municipalities have intimated their intention of coming under the Act, and the Premier stated that it was expected that sixty would do so this year.

Masons' Section of Toronto Builders' Exchange Hold Annual Meeting

THE Masons' Section of the Toronto Builders' Exchange at their recent annual meeting had a large and enthusiastic attendance. The meeting opened with Mr. Geo. Stocker in the chair and Mr. David J. Davidge acting as secretary. Twenty-five members were present.

Mr. Herbert Elgie presented a report on the new standard of measurement for mason work, which was discussed by the meeting and finally passed on to the new executive for completion.

The officers elected for the ensuing year are as follows: President, A. H. Dancy; vice-president, Geo. T. Gayton; treasurer, Jas. W. Hewitt; representative to Builders' Exchange Board of Directors, Chas. Wood; executive committee, Herbert Elgie, C. F. Tilt, and Geo. Stocker; auditors, J. Robt. Page and J. Chalkley; arbitration committee, H. Jennings, C. W. Jackson and J. Robt. Page.

A hearty vote of thanks was extended to the officers of 1918 for the efficient manner in which the business of the section had been handled in the past year. This was responded to by the retiring officers. Several applications for membership were received and favorably passed upon.

Highway Prospects in Quebec

The Quebec Government has been again urged to build a highway between Montreal and Hull via the Counties of Laval, Two Mountains, Argenteuil, Labelle and Ottawa, on the north shore of the Ottawa River. The Hon. J. A. Tessier, Minister of Roads, states that the Government has the matter under consideration. The work will be proceeded with during the coming season.

The Government has also been asked to build a bridge from St. Anne de Bellevue to Ile Perrot and Vaudreuil, and across the Ottawa River at Port Fortune. The Government is willing to make a generous contribution towards the cost—\$300,000—of the first named bridge, but insists that the municipalities interested must bear a portion of the expense.

The primary cause of the shameful surrender of the German Fleet was the loss of morale on the part of the personnel. This was brought about by the strangling effect of sea power on sea communications and the knowledge gained at Jutland that this power was irresistible. The significance of this to an Empire which is absolutely dependent on sea power for its communications is obvious. The lesson to the Empire is that we should never allow our sea power to be called into question. It is our life blood.

(Sgd.) Jellicoe.

Road Foundations, Drainage and Culverts

A Road is as Good as its Foundation—Proper Drainage the First Essential—Some Typical Illustrations

By George Hogarth, O. L. S., M. E. I. C.



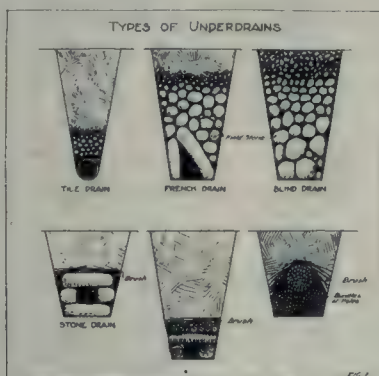
Mr. George Hogarth

IN highway construction, it is essential that careful attention be given to the foundation and drainage of the roadway in order to provide the surface material with that firm and uniform support so necessary to its life. A dry earth subgrade, when properly drained and compacted, is the real foundation of the road, and such subgrade, by its strong and permanent support, materially lessens the need for thick and expensive road surfacings. In

many instances, this ideal condition of the subgrade may be attained by one or several of the many layouts of tile drainage; and any expen-

very often produce a hard natural soil roadway upon which a gravel or macadam surface or pavement may be placed; and under such circumstances, less gravel or stone will be required to produce a good surface for travel.

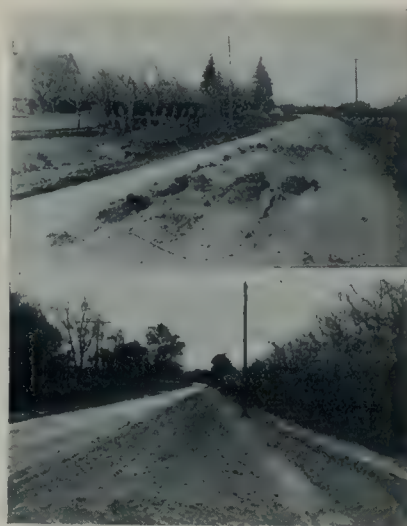
While the earth subgrade in a dry state will carry all the loads passing over the highway, it will be found that certain natural conditions render it impossible to maintain this condition; and wet weather requires that



Types of under-drainage

diture made to drain away water and render the subgrade unyielding, will always give a splendid return in reduced maintenance charges. A comparatively small expenditure for tile drains and open side ditches will

*Chief Engineer Ontario Department of Highways, before the Good Roads Conference.



A good example of "Before and After"

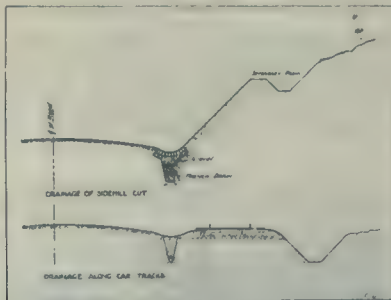
some other means must be provided for distributing the concentrated wheel loads over the subgrade. To properly distribute the wheel loads, a base or foundation course is used in the construction of highways. The importance of this foundation course to the highway is such that a foundation failure will cause the surface above it to fail.

The foundation course may be gravel, field stone,



Typical bridge and culvert designs and views, Ontario Highways Department

oversize stone, quarry stone, Telford, or any existing pavement. The lower course of a macadam road when built in two courses is the foundation for the upper or wearing surface. Under ordinary circumstances, this course is about six inches in depth after rolling. Where the subsoil is poor, or it is desired to aid the subdrainage of the roadway, the lower course may be increased in thickness. A Telford foundation may be constructed and usually consists of stone 6 to 8 inches deep, 3 to 8 inches wide and 6 to 15 inches long laid on edge and with the longest dimensions across the road.

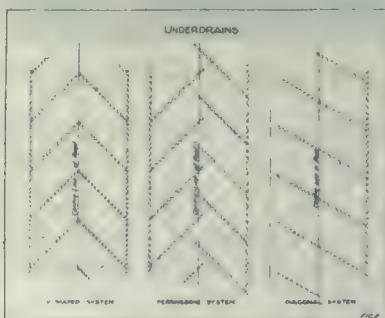


Upper—drainage of side hill cut
Lower—drainage along car tracks

The spaces between the stones are filled with spawls and screenings after which the entire surface is thoroughly rolled.

Concrete as a foundation is used for city pavements and consists of crushed stone, sand and cement in the proportions of one part cement to two parts sand to five parts crushed stone.

Old macadam pavements may be cleaned and swept and used as foundations for bituminous surfaces and



Underdrains: V-shaped, Herringbone, Diagonal

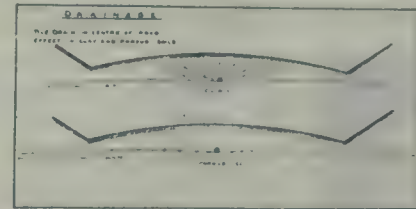
very good results are frequently secured where this process is carried out.

Drainage

For road drainage, porous tile or vitrified pipe may be used, and a diameter of not less than 4 inches usually gives good results. A properly graded trench in which to lay the tile, is first prepared, and after placing the tile and covering or filling the joints, the trench should be backfilled with porous material such as gravel or crushed stone. The entire purpose of such tile is to intercept the flow of ground water before it reaches and softens the subgrade; and in wet and boggy soils, such treatment will produce excellent results. This particularly applies to a road on a hillside or a road at the foot of a slope. The flow of ground water naturally tends to break out at the side of such a road and, unless checked, will produce such a boggy condition that no road can be maintained. Tile drains may be placed in the bottom of the side ditches of the road,

or in the shoulder of the road, or in some cases under the centre of the road; and in all instances, the trench should be at least three feet deep.

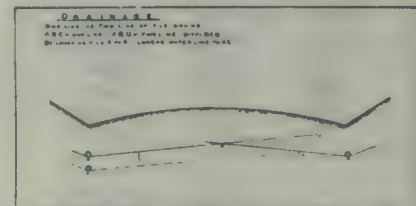
Adequate tile drainage prevents the heaving action of frost removing the water before damage can occur.



Tile drain in centre of road—clay and porous soils

A road on a wet undrained bottom will always be troublesome and expensive to maintain and it will be economical in the long run to go to considerable expense to make the drainage of the subsoil as perfect as possible.

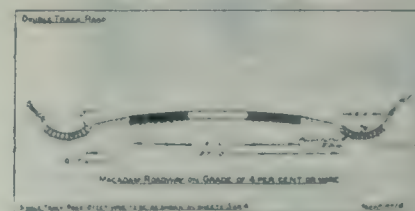
The objects of underdrainage are to lower the water level in the soil and keep it away from the road foundations. The sun and wind will dry the surface of the road but a soft foundation will soon result in the road becoming a mass of mud. Underdrainage also assists in drying the ground rapidly when the frost first comes out of the ground in the spring. A good



Drainage—One line vs. two lines of tile

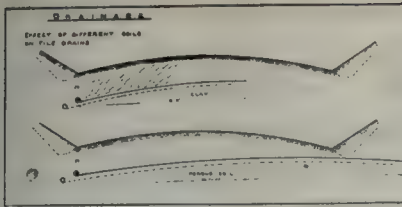
system of tile drainage as stated above will also remove the underflow of ground water so that ground which is comparatively dry in the fall will remain so and not become waterlogged in the spring. Water is frequently found to be forced to the surface of the ground by pressure from water in higher places, and if this water is not drawn off by underdrainage it saturates the soil and rises as the frost goes out. Underdrainage not only removes the water but prevents or reduces the destructive effects of frost.

Open side ditches or gutters are necessary in order to receive and carry away all water from the surface of the travelled roadway and the surrounding land.



Macadam roadway on grade of 4% or more

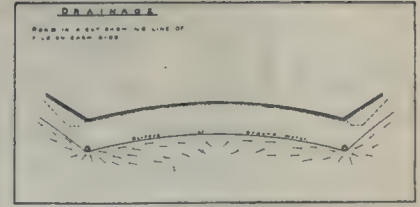
Side ditches should be of adequate depth and should have as great a fall as possible to a free and clear outlet. Crowning the roadway gives the transverse slope which sheds the water to the side ditches. On earth roads a slope of one inch per foot will be found satisfactory, while for the macadam roadway and the higher types of pavements a flatter slope of from $\frac{3}{8}$ to $\frac{1}{4}$ inch per foot is ample. For ease in construction, a



Effect of different soils on tile drainage



Road on a hillside, showing effect of a line of tile drain on water level

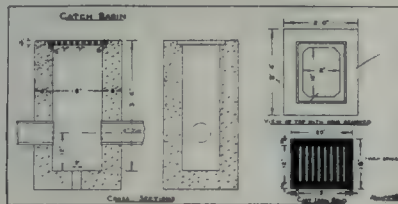


Road in a cut showing line of tile on each side

side ditch cross section having a bottom width the same as a drag scraper is economical as giving a size which is readily constructed and easily maintained.

Culverts

Culverts should be constructed of permanent materials, should be large enough to take the maximum flow of water, should be graded so as to be self cleaning and should be long enough to take the normal width of the roadway section between parapets. The size of opening necessary may be determined usually by a close examination on the ground and after making enquiries as to the greatest flow of water to be expected. In using pipe for culverts, it is not advisable to use a smaller diameter than 12, or better, 18

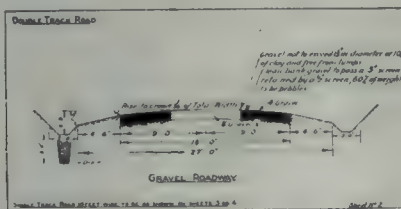


Views of catch basin

inches, because of the liability of the smaller sized pipes to choke up quickly.

Culverts are required to support the weight of the materials covering them and also the weight of any superimposed loads. Water freezing in the culverts may also cause heavy expansive forces tending to burst or crack the walls of the culvert.

The usual materials used for pipe culverts are, vitrified clay, reinforced concrete, corrugated iron, or cast iron. All pipes should be laid on a firm bedding and



Double Track Roadway

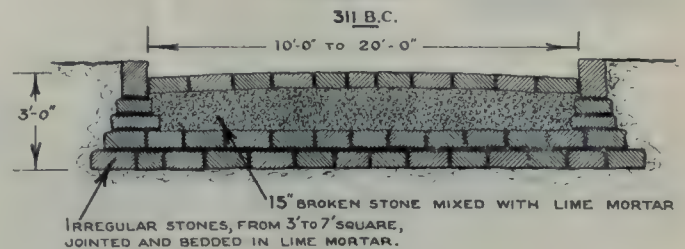
the backfilling carefully tamped around and over the pipe. Headwalls at each end of the pipe should be constructed in every case to prevent the scouring action of the water washing away the supporting soil. Frost action may affect the headwell, and, for that reason, the foundation should go to a sufficient depth to reach below the usual depth to which frost penetrates. Headwalls should also be long enough to prevent the earth falling around their ends and blocking the channel to the pipe.

Culverts having an opening of 2 feet and upwards in width are usually built of reinforced concrete and

may be of the box type, or bridge, or arch, depending on the span. Spans of 2 feet to 16 or 18 feet may have a flat slab top with vertical sidewalls as the forms for such construction are rapidly framed at small expense. The reinforcing of the slab may be composed of any of the usual forms of concrete reinforcing steel such as bars, rods, expanded metal or wire. Where the span

ROMAN ROAD.

APPIAN WAY



is over 18 feet, it is advisable that reinforced concrete beams or steel beams be used to support the reinforced concrete roadway slab. The roadway slab where not carrying a fill is usually constructed from 6½ to 7½ inches in thickness depending on the spacing of the supports, and a richer mix of concrete is used to give a greater resistance to wear.

The location of culverts is a matter requiring careful judgment and it is often found that they are built and maintained where unnecessary. To secure proper benefit from a culvert, the water carried across the road should be carried from the end of the culvert directly away from the road. Water may be carried along a road wherever the volume is not sufficient to cause washing and scour.

Some Halifax Bridges

IN connection with the Ocean Terminals, the Cook Construction and Wheaton Bros. have constructed in Halifax 12 bridges and two subways, the former - being fine. types of reinforced concrete work. These bridges cross the government railway lines; they were commenced in July, 1916, and completed in November, 1917. The railway lines will give access to the Ocean Terminals, and are cut through solid rock, the cuttings being from 20 to 65 ft. deep. There are no grade crossings, these being avoided either by the bridges or the subways. The bridges are very handsome structures of the solid panel and open dado types; Young Avenue and Tower Road being of the balustrade type of handrails. The concrete surface was tooled finished with Berg rotary surfacers and bush hammers. The foundations are on solid rock. The roads are macadamised and the side walks are of concrete. The lighting is by electricity, lamps being mounted on four corner pilasters.

Build Permanent Road Surfaces

A Detailed Analysis of the Methods of Constructing the Various Types of Surface—Importance of Properly Gauging Amount of Future Traffic

By R. Crawford Muir, A.M.E.I.C., A.M.I.M.E.*



Mr. R. C. Muir

THERE is a great variety of road surfacings. The chief permanent surfacings for highways and rural roads may be classified as follows: Bituminous Macadam (penetration method), Bituminous Concrete, Cement Concrete and Brick. I speak merely of the surfacings used in rural road work and not of the more expensive paving used in cities.

At the outset let it be said that the word permanent as embodied in the title of this paper

is rather misleading and is not always appreciated by the tax-payer. There is no permanent road surface in the full sense of the word. Traffic and other causes will destroy any kind of road surface, and adequate provision must therefore be provided for the upkeep of the surface.

When the traffic is too heavy for water-bound macadam more permanent types of road surfacings become necessary.

The desirability of changing from the water-bound macadam road was brought about unquestionably by the action of increasing motor traffic. The earliest endeavors to meet some of the difficulties were by applying a surface treatment of oil or tar to the existing surface. This in some cases had satisfactory results, but with the advent of the motor truck something more substantial had to be laid.

BITUMINOUS MACADAM

A bituminous macadam surface consists of broken stone and bituminous materials incorporated together by penetration methods. Formerly this form of construction was simply called penetration macadam.

The bituminous material, hereinafter called binder, used in this surface may be either asphalt or refined tar.

This type of surfacing is laid on an old macadam road, and occasionally on a newly constructed macadam road; sometimes a cement concrete foundation is used.

The subgrade or foundation should be prepared with the greatest of care. Adequate drainage and a thoroughly compacted subgrade are essential for all types of surfacing. Improper foundations have been the source of many failures of various types of surfaces.

Foundation

If the surface is to be laid on an old macadam road, which requires reshaping, the existing surface should be scarified to the desired depth and sufficient new stone added to bring the surface to the required grade. Should the existing road surface be in a uniform condition, scarifying will not be necessary, but the surface must be thoroughly swept and cleaned, all fine mater-

ial that is caked on the surface should be loosened and removed. The coarse stone should be exposed, so that the bituminous binder may adhere well.

Base Course

If the base course is to be composed of crushed stone as in a water-bound macadam road, the thickness of same will depend on the strength of the foundation or subgrade. This course should be thoroughly compacted and well filled with stone screenings or coarse sand. The filling of this course is most important. It is essential that there shall be no voids to absorb the bituminous binder or to allow the subgrade material to work up into the base. Any surplus material used for filling is swept off before applying the top course.

Wearing Course

On the prepared base, the stone for the top or wearing surface is spread. Care must be taken to obtain a uniform distribution of the stone. An uneven density is the cause of many failures in this type of surfacing.

The size of stone used is usually of a size that will be retained on a 1-inch opening and pass 2½-inch opening. This may be varied to suit the qualities of the stone. The point is that a wide variation in size of the stone causes an irregular delivery; one load may run all fine and the next load all coarse stone. This condition is detrimental to the surface of the road. The stone must be absolutely clean and free from dust. Dirty stone will never produce a good bituminous macadam surface.

The layer of stone should be spread to such a depth that after rolling it will have a thickness of 3 inches. This course is rolled dry until the stones have become firmly keyed together. At the same time it must be open enough to admit the bituminous binder. Care must be exercised in rolling this course; frequently in rolling, the stones are crushed thereby preventing the binder to penetrate.

Applying the Binder

On this firm, but open surface, the bituminous binder is applied at the rate of 1½ gallons to the square yard by means of a pressure distributor at a temperature of approximately 250 deg. F, the binder being applied in the form of a spray. These distributors have wheels with tires of sufficient width not to make any appreciable rut in the surface of the road.

Like the stone, the binder must be spread with absolute uniformity. The object is to penetrate the wearing course to a depth of 3 inches. It will avail little if the average of two yards is correct, with one yard containing almost all the binder and the other hardly any. Every square yard should be like every other square yard. The spaces between the stones should show.

Covering of Stone Chippings and Rolling

After the binder is applied, a layer of stone chippings is spread over the surface and the road rolled thereby forcing some of the stone chippings into the

*Assistant Engineer, Department of Public Highways of Ontario, before Ontario Good Roads Conference.

interstices. The stone chippings must be free from dust.

Seal Coat

After this surface has been swept clean of all uncemented stone chippings and dust, a seal coat of hot bituminous binder is applied at the rate of 1-3 gallon to the square yard. It is important that the surface must be free from dust before applying this seal coat; if not, then the bituminous material will peel off. The seal coat is then covered with dry dustless stone chippings or pea gravel and again rolled. The rolling is continued until a smooth surface is produced. The road is then opened to traffic.

Crown

The cross fall given to this type of surfacing is $\frac{3}{8}$ -inch to the foot.

Bituminous Sand-Grout Surfacing

The bituminous sand-grout surface has not been developed in this country, but from the standpoint of a low cost urban road it is very interesting.

This type of surfacing has been used in Britain and in the State of Massachusetts with very satisfactory results.

The method of construction is similar to bituminous macadam, already explained, with the exception, that sand is mixed with the bituminous binder.

A few years ago the writer constructed this type of surfacing on a short stretch of road and the method of construction was briefly as follows:—

The existing macadam road surface was thoroughly swept before applying the crushed stone of a size passing a $2\frac{1}{2}$ -inch opening and retained on a $1\frac{1}{4}$ -inch opening; this was rolled until the stones had keyed together.

The sand, which was very fine and clean, was dried and heated. The tar was heated in a large kettle. A trough, about 2 feet deep, was used for mixing the tar and the sand, the matrix being well agitated. The trough was mounted on wheels and was moved as the work progressed. At one end of the trough was a pipe



Fig. 1—The Story of Road Making: No. 1, scarifying existing surface; No. 2, preparing scarified surface; No. 3, macadam base ready to receive paint binder coat; No. 4, applying binder coat; No. 5, dumping hot mixture; No. 6, shovelling and raking hot mixture; No. 7, 10-ton roller; No. 8, applying seal coat of hot asphalt cement; No. 9, applying hot sand after seal coat; No. 10, rolling finished surface; No. 11, finished road; No. 12, mixing plant, showing elevators for conveying mineral aggregate to the drier.

outlet and a valve through which the matrix flowed into the pouring cans.

The hand pouring method was adopted in applying the matrix to the road surface. The quantity of matrix used was approximately $2\frac{1}{4}$ gallons to the square yard at a temperature of approximately 200 deg. F. After the application of the binder, a thin covering of stone chippings was spread over the surface and the surface rolled with a 12-ton roller. The surplus stone chippings were then swept off and a seal coat of hot tar was spread over the surface, which was covered with stone chippings and thoroughly rolled.

BITUMINOUS CONCRETE SURFACES

Bituminous concrete surfaces differ chiefly in the character of the mineral aggregate and the bituminous

Mineral agg'te passing 4-mesh .. 8 to 22 per cent.
Mineral agg'te passing 2-mesh not over 10 per cent.

The sieves are to be used in the order named.

Asphaltic concrete is the name given to a paving mixture composed of graded stone, sand and mineral dust, which is cemented together by an asphalt cement.

The stability of an asphaltic concrete surface depends upon the grading of the mineral aggregate.

Binder Coat

When the base has been prepared a paint binder coat of hot asphalt cement is applied to the surface, at the rate of approximately one-half gallon to the square yard, so as to permit a bond with the hot surface mixture. This is essential on any kind of foundation, but



Fig. 2—Cement Concrete Road under construction. View shows mixer, template for striking to desired shape and steel side forms for holding concrete in place.



Fig. 3—Bituminous Macadam—Spraying bituminous binder under pressure

binder of which the surface is composed. These surfaces may be divided into the following two classes based upon the nature of the mineral aggregate.

Class No. 1. Mineral aggregates composed of crushed stone either alone or mixed with sand.

(a) One size of crusher-run stone.

(b) Combinations of one size crusher-run stone and fine mineral matter, such as sand or stone screenings.

(c) Graded aggregates of crushed stone either alone or mixed with other material matter.

Class No. 2. Mineral aggregate composed of gravel, slag or shells.

The bituminous binders used in the construction of bituminous concrete surfaces are asphalt and refined tar.

Like a bituminous macadam surface, already explained, bituminous concrete surfaces can be laid on an old macadam road, new macadam road or on a cement concrete foundation.

Asphalt Concrete

The type of surfacing usually constructed is called asphaltic concrete and it is such a type that will be discussed in this paper. The mineral aggregate all passes a $1\frac{1}{4}$ -inch opening and is so graded as not to infringe any patents. The type of surfacing generally constructed is under the following specification known as the Topeka specifications:

Bitumen 7 to 11 per cent.
Mineral agg'te passing 200-mesh .. 5 to 11 per cent.
Mineral agg'te passing 40-mesh .. 18 to 30 per cent.
Mineral agg'te passing 10-mesh .. 25 to 55 per cent.

all surplus dust must be removed before applying the binder coat. The binder coat is applied immediately ahead of the laying of the surface mixture.

Mixing and Laying

The materials comprising the wearing surface are heated and mixed in a standard paving mixing plant. This plant consists of a rotary drier in which the mineral aggregate is dried and heated; two compartment storage bins, one for sand and the other for stone; there are also three melting tanks for the asphalt, arranged for air agitation. There are two elevators to feed the mineral aggregate to the drier, one for stone and one for sand, also an elevator from the drier to the bin. The mineral aggregate is weighed on a two beam scale, so that the stone and sand can be weighed separately, and the asphalt weigh bucket is on a single beam scale.

The materials are mixed in the following manner: The mineral aggregate is drawn into the measuring box at the desired weight; from there it is discharged into the mixer. The asphalt cement is then added and thoroughly mixed, the filler being added while the mixing is in process. From the mixer the mixture is dumped into a wagon which is directly underneath.

The filler, which is generally limestone dust, plays a very important part in the mixture; the denser the filler, the denser and more stable the mixture or wearing surface.

The mixture is hauled to the road in the usual spreading wagons, dumped on the foundation at a temperature of approximately 300 deg. F. and deposited

in place by means of shovels. It is then spread by hot iron rakes to the desired depth, care being taken that all lumps are broken and a uniform consistency and grade obtained.

As soon as possible after the raking operation, the mixture is rolled with a 10-ton roller. The rolling should continue until no marks are seen on the surface. The heavy rolling aids in securing a union between the wearing surface and the base. The wheels of the roller are oiled to prevent the mixture from adhering to them. The surface is generally compacted to a thickness of 2 inches.

Seal Coat

After the rolling is completed, a seal coat of hot asphalt cement is spread over the surface at approximately 1-3 gallon to the square yard, this is immediately covered with hot sand or dry dustless stone screenings. The surface is then rolled and left to cool before allowing the traffic on it.

CEMENT CONCRETE SURFACE

There are two general types of concrete road, known as the one-course and the two-course. The former consists of one course of concrete, all of which is mixed in the same proportion and composed of the same kind of materials, while the latter consists of two courses of concrete, mixed in different proportions and containing different sizes and kinds of aggregates.

The one-course type is that usually constructed and is the one that will be discussed here. It possesses the advantages that there is no possibility for the top course to separate from the rest of the road, and that the resistance to wear is uniform throughout the life of the road.

However, local conditions may justify the two-course type. For example, if the only materials locally available for the mineral aggregate are of inferior

Subgrade

In preparing the subgrade for a concrete surface, the features which should receive primary consideration are (1) adequate drainage (2) firmness and (3) uniformity in grade and cross-section.

The cross-section of the subgrade may be either flat or shaped to the crown of the finished road. The flat cross-section involves the use of a slight additional quantity of concrete but gives an increased thickness at the centre, where the maximum strength is required. A flat subgrade is generally recommended.

Soil conditions are sometimes such as to make the use of a sub-base desirable. A subgrade which does not compact readily under the roller or which cannot be effectively drained at a reasonable cost, should have a sub-base constructed of gravel, crushed stone or cinders.

Forms

Side forms which control the placing of the concrete should be securely held in place by means of stakes. Ordinarily the forms may consist of 2½-inch planks having a width equal to the thickness of the road, but for long stretches of work steel forms are to be preferred. The forms must be kept to a true alignment, the ends of the different sections, therefore, should be fastened or held firmly in place in order to prevent displacement of the concrete.

Mixing and Placing

The fine and coarse aggregate are piled on opposite sides of the subgrade and kept separate and in such quantities that unnecessary labor and time will not be required to wheel the materials long distances to the mixer. The cement is piled on boards and along the shoulder of the road and sheltered from the weather.

The materials used in concrete roads should be of



Fig. 4—Cement Concrete Roadway Completed



Fig. 5—Cement Concrete Road—Finishing with wooden float from bridge

quality, it might be more economical to use them in the lower course of a two-course type and import the aggregate for the top or wearing course than to employ the one-course type and import all the aggregate.

In the case of two-course roads, it is important that the top course be placed before the concrete in the bottom course has taken its initial set.

The bottom course is usually mixed in the proportions of 1 part of cement to 2 parts of sand to 4 parts of crushed stone and laid at a depth of 4 inches. The top or wearing course is mixed in the proportions of 1 part of cement to 1½ parts of sand to 3 parts of crushed stone and laid at a depth of 3 inches.

good quality and clean in every respect. This is absolutely essential.

The materials are mixed in a standard mechanical mixer in the proportions of 1 part cement to 1½ parts of sand to 3 parts of crushed stone.

The greatest care should be taken in placing the concrete to insure a uniform texture of the surface. The concrete must not be mixed too wet, or separation of the aggregates will occur when the concrete is deposited.

Finishing

After the surface has been struck off to the desired shape by means of a template, it is finished with a wood

float, the men working from a bridge which spans the road. The templates or strike board is drawn along the side forms.

In place of finishing with the wooden floats, the most recent practice is to use a roller and belt method. This method involves the rolling of the concrete after it has been struck off, by means of a metal roller weighing approximately 100 lbs. On narrow roadways, the roller is operated from one side of the road. On wide roadways, bails are attached to the roller to which a rope is attached and the roller pulled across the road. The roller is operated at an angle with the centre line of the road so that it advances along the surface after each time across.

After the rolling, the concrete surface is finished by two applications of a belt made of canvas or rubber belting not less than 6 inches wide. The belt is applied with a combined crosswise and longitudinal motion.

Curing

Concrete that dries out is much inferior to concrete that is kept moist and sets properly and therefore it is necessary to protect the surface from drying and furnish plenty of water for the setting.

As soon as the concrete has been floated and finish-



Fig. 6—Laying brick on sand cushion on 5 in. concrete base

ed it is covered with canvas and after the concrete has set sufficiently, it is covered with about 2 inches of loam; this is kept moist for 10 to 14 days, when the loam is removed.

Joints

It is customary to provide transverse joints at regular intervals in concrete roadways, to prevent irregular cracks. Concrete contracts and expands with changes in temperature and also with changes in its moisture content.

The practice is to place expansion joints at intervals of 25 to 50 feet. These joints are from $\frac{1}{4}$ to $\frac{3}{4}$ -inch wide. Steel plates have been used extensively for these joints, but experience seems to indicate that the metal plate is unnecessary. A prepared elastic felt is now used for the purpose.

Reinforcement

Reinforcement of some kind is recommended for concrete roads for the purpose of preventing cracks and to distribute the stresses due to temperature and moisture. Wire mesh or expanded metal is usually used. Where bad foundations are encountered, reinforcing is necessary to care for these conditions.

Crown

The cross fall given to a cement concrete road is usually 1-96 of the width.

BRICK SURFACING

This type of surface is mostly laid on a cement concrete foundation. There are two kinds of brick used, the repressed brick and the wire-cut lug brick. The wire-cut lug brick is the most extensively used.

It is extensively used on very steep grades, for such there is a special hill side brick manufactured.

Sand-Mortar Cushion

Formerly the brick were laid on a sand cushion, $1\frac{1}{2}$ inches thick on the top of the concrete base, but on account of the vibration from traffic tending to shift the sand cushion a mortar composed of 1 part of cement to 3 parts of sand is now used as a cushion.

The sand and cement are mixed dry and spread on the concrete foundation at a depth of 1 inch and levelled by means of a template.

On this cushion the brick are laid at right angles to the curb with the best face up and the lugs all in the same direction. After five or six rows have been placed, they are closed up by driving with a maul. This is done to make the cross-joints as close as the lugs will permit.

After the brick have been laid, the surface is cleaned and all defective brick replaced with good brick.

The brick are then rolled with a roller weighing 2 to 4 tons, thereby bringing the brick to a true surface.

The surface is then lightly sprinkled and the water penetrates the cushion in sufficient quantities to cause the cement to set.

A cement grout filler is used for filling the joints between the brick thereby uniting the surface into a monolithic layer.

The filler is composed of 1 part of cement to 1 part of sand and is mixed dry, then water is added thus forming a liquid mixture of the consistency of thin cream. This mixture is spread over the surface and brushed into the joints by means of squeegees and brooms.

In place of laying the brick on a sand or sand and mortar cushion, the latest practice is to lay the brick directly on a freshly placed concrete base and roll the brick to bed them in the concrete before it takes a set.

Conclusion

The chief points which should determine the selection of a type of surface are:

(1) The volume and nature of the traffic over the road.

(2) Conditions incident to the location of the road; including the character of the adjacent land and improvements; the character of the foundations; the existing grades; the climatic conditions; and the cost and availability of materials.

The volume and nature of traffic—not the present traffic, but the traffic after improvement—is the most essential point. This must necessarily be approximately estimated and due allowance should be made for increase during the life of the road.

The conditions necessary to produce a good surface are:

(1) Proper sub-drainage.

(2) A stable foundation.

(3) A high grade and uniform mineral aggregate.

(4) The road prepared and laid in the proper manner.

The above conditions are not easy to obtain, yet if anyone of them is neglected the life of the road is greatly shortened.

New Filtration Plant at Lindsay, Ont.

Chemical Dissolver for Alum Solution Proves Highly Successful

THE water filtration plant recently installed for the Board of Water Commissioners at Lindsay, Ontario, is one of the most up-to-date plants of its kind on the continent. The plant is located at the foot of Mary St., on the west side of the River Scugog, and at a point which gives no possible chance for sewage to enter the river. The only water that enters the Scugog, south of Lindsay, is that which flows down the small spring creeks in the early summer and that which comes from tile drains laid down by farmers, which are very few. The latter carry no deleterious germs as the water is well filtered coming through the soil.

There are several novel and interesting features about the design of the system which make it quite different from the usual filtration plant.

Ozone Treatment Discussed

Delving lightly into history, it may be said that previous to the installation of the new filters, Lindsay had the only municipal waterworks plant in Canada

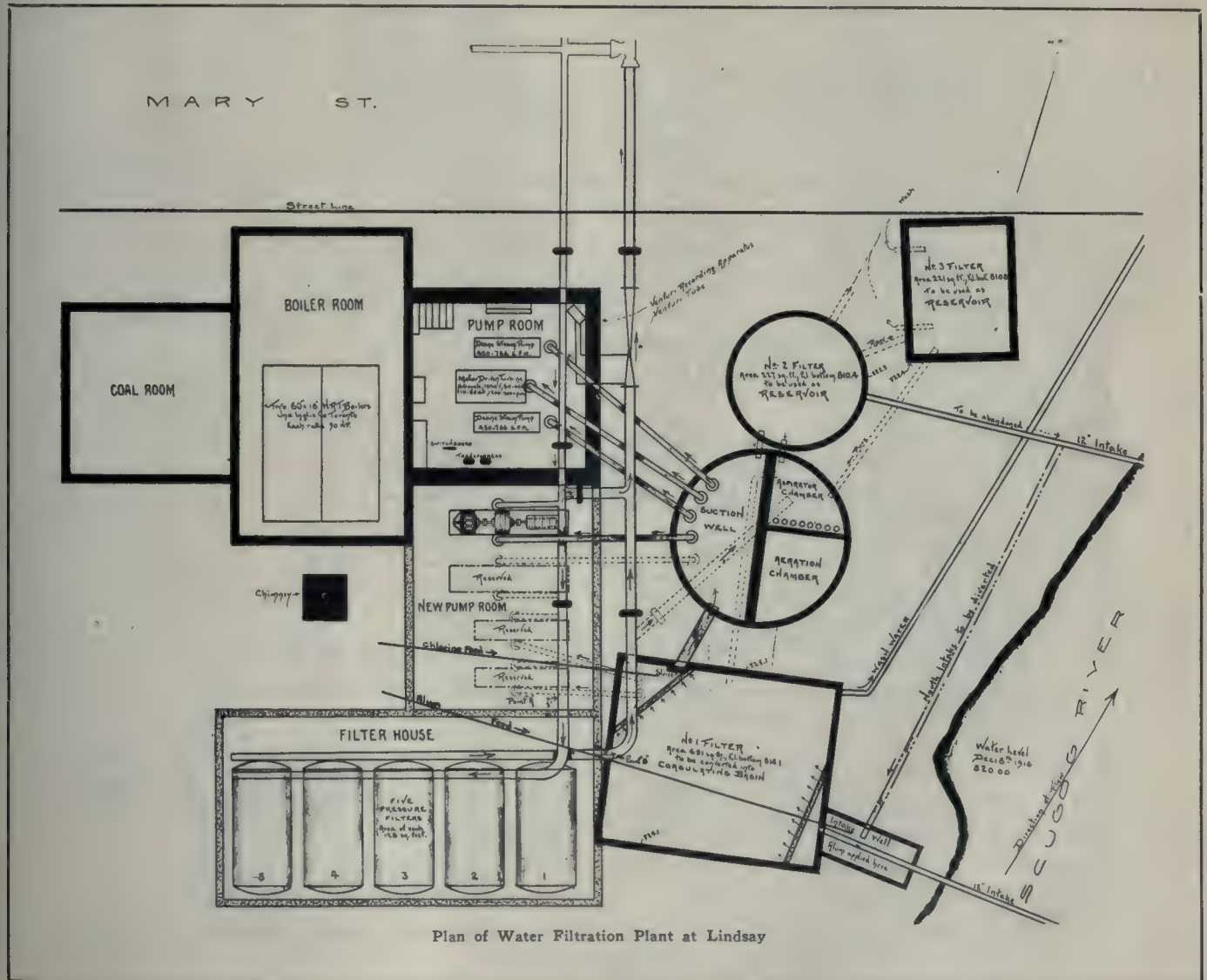
for the treatment of the public water supply with ozone.

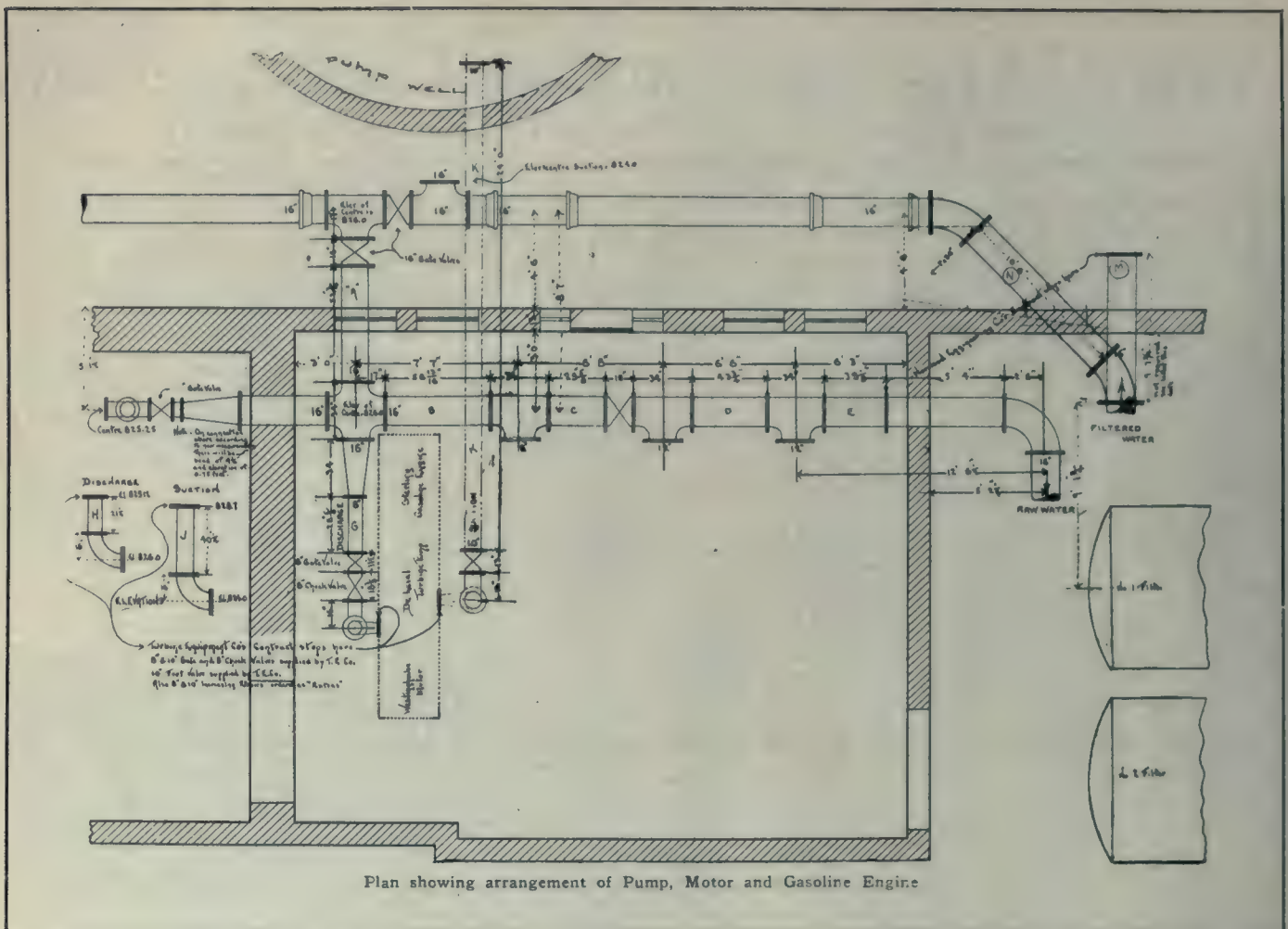
Briefly described, the old plant consisted of three roughing filters of the gravity type into which the water flowed by gravity from the Scugog River and from which it was carried to a part of the main suction well where it was treated with ozone. The roughing filters contained about two feet of sand and were equipped with the usual sand valves, manifold and wash water troughs.

Without entering into any discussion of the relative advantages of the ozone treatment of water and filtration through sand, suffice it to say that sufficient information was obtained to warrant the Water Commissioners in abandoning the ozone plant and installing mechanical filters.

Old Plant Remodelled

The largest of the old roughing filters has been remodelled and converted into a sedimentation basin into which all of the raw water flows from the river.





Advantage was taken of the existing manifold system in the floor of this old filter, the sand valves being removed and the main "pure water" pipe connected to a sludge manhole into which the sediment is forced by hydraulic pressure and from which it is removed with a 4-inch centrifugal pump supplied by the Boving Hydraulic and Engineering Works of Lindsay. This pump has exceptionally large openings through which solids up to $1\frac{1}{2}$ inches may easily pass.

Baffles were placed in the sedimentation basin to give a uniform flow across the whole width.

The solution of alumina sulphate is supplied to the water as it enters the sedimentation basin.

Chlorine Solution

A 16 inch C.I. pipe laid on the floor of the sedimentation basin at the opposite end from the inlet conveys the coagulated water to the suction well, which is the same well as used in the old plant. A Venturi tube is placed in this 16 inch pipe line to regulate the flow of coagulated and liquid chlorine. Liquid chlorine solution is applied as the water enters the above described 16 inch pipe.

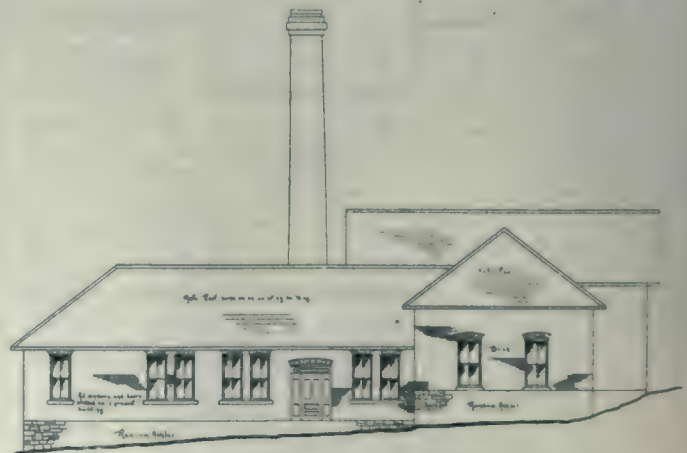
Pumps take the coagulated and chlorinated water and force it through the pressure filters into the main discharge pipe and thence through a Venturi tube to the distribution system of the town. Provision is made for by-passing the filters and pumping chlorinated water directly into the mains.

The old pumping plant consisted of two 750 g.p.m. compound duplex pumps and one 75-100 h.p. two speed motor driving a 1,000 g.p.m. Mather & Platt two stage centrifugal pump, the lower speed being used for do-

mestic purposes and the higher for fire purposes. This plant will continue to be used.

The new pumping unit consists of a 6-inch De-Laval two stage horizontal split casing centrifugal pump driven on one end of its shaft by a 75 h.p. Westinghouse motor and on the other end of its shaft by a 150 h.p. 6 cylinder Sterling marine type gasoline engine.

The capacity of the pump when driven by the motor at 1,150 r.p.m. is 833 Imperial g.p.m. against 196



feet head and when driven by the Sterling engine at 1,450 r.p.m. is 1,100 Imperial g.p.m. against a total head of 290 feet.

The Sterling engine which was made by the Sterl-

ing Engine Company, of Buffalo, N. Y., is fully equipped with electric starter and lighting system so that in case of failure of the electric power the engine may be started in an instant and water obtained for domestic

and had an effective size of 0.45 and a uniformity coefficient of 1.5.

The filters and pipes are painted a battleship gray enamel, the edge of flanges being dead black. This gives a very striking and sanitary looking appearance to the plant.

Chlorine Apparatus

The liquid chlorine apparatus was supplied by Wallace & Tiernan of New York and is of the automatic type, being controlled from the Venturi tube located practically at the point of application of the chlorine. The entire apparatus is mounted on the wall of the filter room and surrounded with a gas proof glass partition provided with a plate glass door which is kept locked.

New Chemical Dissolver for Alum Solution

The arrangements for preparing the alum solution are distinctly novel and, instead of presenting the usual jumbled appearance of tanks, motors and gearing, are one of the show parts of the plant.

The dissolver is placed close to the alum storage and the mixing tanks are located out of the way, up near, or above, the ceiling, wherever is convenient. The orifice box is placed convenient for inspection and high enough above the floor to give a good gravity flow to coagulating basin. These three parts are connected together with lead pipe. Reference to the illustration will show clearly the lay-out of this system.

The alum to be dissolved is placed in the "Dissolver" and the cover is closed. The operator opens the valve marked "In" on "Switchboard" and in two hours the alum solution is in the overhead tanks filtered and thoroughly mixed and the water supply to the chamber is automatically shut off. A definite weight of alum is mixed with a definite quantity of water, giving a solution of definite strength.

The discharge from the chamber into the tank is cut down to a nozzle because of the fact that the first



View of Water Filters

or fire purposes and sufficient electric light may be had for operating the plant.

The pump, motor and engine were supplied directly by the Turbine Equipment Company of Toronto.

Pressure Filters

The pressure filters, which were supplied by the Norwood Engineering Company of Florence, Mass. were manufactured at Cowansville, Que. They are of the usual horizontal type, 8 ft. diameter and 18 ft. long overall. There are five filters. The arrangement of the piping in front of the filters is exceptionally simple and convenient. The sand used was from Cape May

Solution under Pressure.

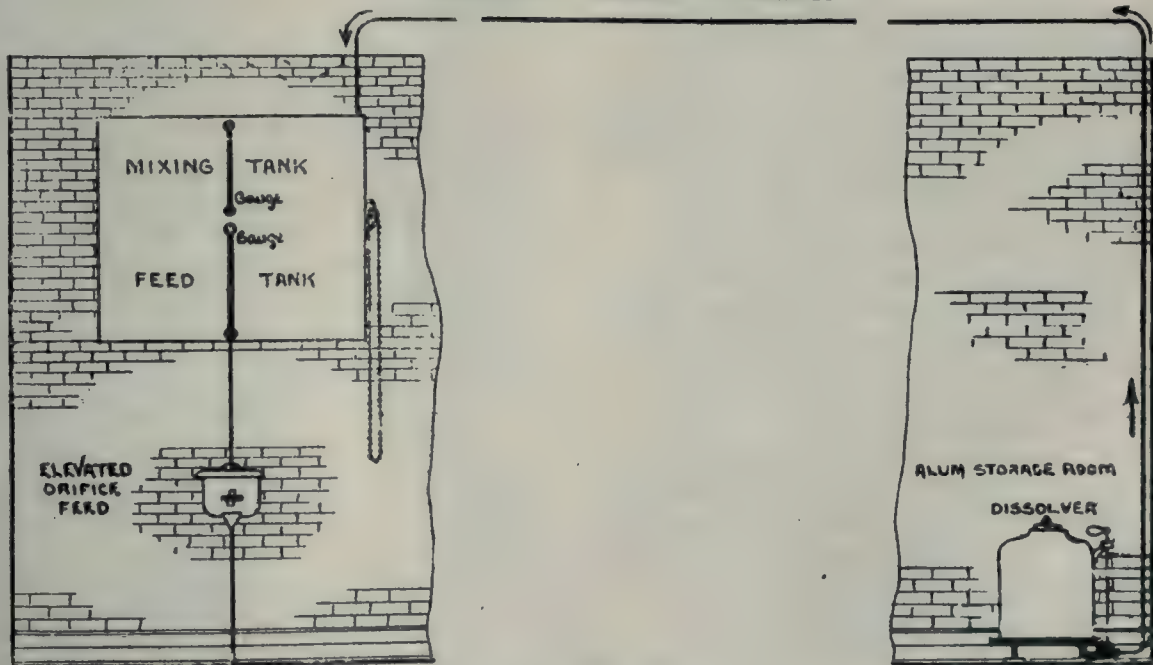


Diagram of installation of Chemical Dissolver Equipment

solution to come over is a saturated solution and the last to come is practically pure water and the nozzle causes a churning action in the tank which thoroughly mixes the solution. This apparatus was designed by F. W. Thorold Civil Engineer, Toronto, and has been fully covered with patents.

The alum feed is through a Norwood automatic controller operated from the same Venturi tube as the liquid chlorine feed.

Samples of the alum solution being fed to controller



Section through Chemical Dissolver

may be taken at any time by simply opening a cock on the switchboard and filling the hydrometer tube.

The master pressure gauges showing pressure in raw and filtered water pipes are also placed on the switchboard as are also graduated rods showing the depth of water in the alum tanks, and glass tubes showing the water before and after filtration.

Water Measured

The output of water from the pump house is measured in a Venturi tube supplied by the Builders Iron Foundry of Providence, R. I., and is indicated, recorded and registered on one of their type "M" instruments.

Washing the Filter

After twelve hours of a run, the filters are cleaned and freed of all waste matter which has collected during that period of filtration. To do this the system is reversed and all water shut off. The filtered water from the other units is forced back through gravel and sand, which removes all dirt from the sand and which is carried out into a steel trough from which it passes into a drain. This operation lasts eight or ten minutes when the filter is again ready to go on with its work. Meters register the amount of water consumed

each day and a recording gauge indicates how much is used each minute.

Capacity of Filters

The capacity of the filters is 250 gallons per minute for each one, or 1,850,000 gallons per day. The plant will be one of the best in Ontario and installed according to plans meeting with the approval of the Inspector of the Provincial Board of Health.

The plant was designed by Kerry & Chace, Limited, consulting engineers, Toronto, and was built under the personal supervision of Mr. F. W. Thorold, B.A.Sc., Toronto.

Revisions in Toronto Building Code

MORE definite information is available in regard to the revised building code for Toronto, to which passing reference was made in the last issue of the Contract Record. It appears that the severity of present building regulations will be mitigated by a revised live-load requirement for various types of buildings. The following table will give an indication of the reduction that has been determined upon by the city architect's department:

Live Load per Square Foot

	Present By-law.	New By-law.
Residences	50 lbs.	40 lbs.
Schoolrooms	75	60
Do. corridors	100	75
Churches, theatres	100	90
Cafes	100	90
Offices	70	60
Garages and stables	150	125

The thickness of walls for stables, garages and sheds of less than 800 sq. ft. area has been reduced to 14 in. and 9 in., where formerly 18 in. or 14 in. were required. Dwellings would not benefit by this ruling, but the rooms may be made 8 ft. high instead of 8½ ft. These changes will tend to somewhat cheapen the cost of building without proving detrimental to stability.

The revised code will show a more satisfactory arrangement of the subject matter than the existing by-law and will include a chapter on the flat-slab system of concrete construction, which is not covered in the present code. The new regulation will contain no references to the exits, widths of aisles, fire escapes, widths of stairs required in theatres, since the provincial government has passed legislation covering these factors and the city will have no control over their design. Concessions are to be made in favor of buildings in which brick are laid in cement mortar, instead of lime mortar.

Good Roads in Great Britain

Reports from Great Britain indicate that a road improvement programme is being considered involving an expenditure of \$500,000,000. This outlay will be spread over a period of years as it would be impossible to obtain sufficient materials to carry out such a comprehensive programme within a year. The first cargo of asphalt that has gone to England in three or four years was recently shipped by the General Asphalt Co.

The Glass Situation Affected by War

By Mr. J. E. Harrson*

IT is generally agreed that there is a very serious shortage of dwelling houses, particularly of the artisan class, throughout the Dominion, owing to the cessation of building operations during the last two three years. The Government of Ontario was alert to the necessity of encouraging house building, and has recently introduced legislation whereby assistance will be afforded to small investors in the form of loans at a low rate of interest to enable them to build homes. Numerous other projected buildings, public and otherwise, have been held up by the authorities and owners awaiting the successful conclusion of the war, and reports from various points indicate that many of these will be proceeded with in the spring; in fact, large contractors already report enquiries heavier than usual. Therefore, I think, all things considered, a feeling of optimism should prevail in the building and kindred trades.

As in the case of other commodities, it is difficult to forecast what is likely to take place with regard to supplies and prices of glass in the current year, owing to the peculiar conditions which will prevail during the period of readjustment and reconstruction. However, I propose to analyse briefly the situation according to reports emanating from different countries, confining my remarks chiefly to window glass.

Situation Analyzed

Until August, 1914, Canada drew the bulk of her supplies of glass from England and Belgium, and a part of the demand was met by the output of our factory in Canada, which, by the way, commenced operations in May, 1914, but on the outbreak of war, supplies from England and Belgium were quickly cut off, and since that time the requirements of this market have been, and continue to be supplied by the many United States manufacturers and the output of our plant at Thorold, Ontario.

Doubtless the foremost question in your minds is: When will supplies from England and other European countries again be available? I have no official information on this point, but reports and despatches during the last three months appear to confirm that the equipment of practically all the coal mines in Belgium and the north of France, after being used by the enemy during the war for his own purposes, were deliberately destroyed by the German armies at the time of the final retreat, and, worst of all, the mines were also flooded. As you may know, producer gas plays a very important part in the manufacture of glass, being used in the melting of the ingredients and in the flattening and annealing processes. Many of the railways and steel works in those countries were also completely destroyed by the Germans after they had taken away the metal and machinery. It is, therefore, safe to assume that it will take many months, perhaps a year or two, to get the coal mines and the other industries to which I have referred, in full operation again. In the meantime Belgium and France will have to look to other countries for coal supplies.

Apart from the shortage of coal required for gas-making the labor situation will cause concern for some

time to come. The manufacture of glass calls for highly skilled labor, most of the workers serving from four to seven years' apprenticeship before becoming proficient. A large number of Belgian glass-makers—and this also applies to England—have been killed or disabled in the war, and during these four years there have been no apprentices in training. It may be of interest to you to know that the firm I represent in Canada has a factory in Maubeuge, on the northern border of France and I have news that this was used as a gun repairing shop by the Germans and that every piece of machinery was plundered or destroyed by the enemy. This condition will doubtless apply to many other factories which were all practically within the war zone for the entire period of hostilities. The conclusion is that a long time will elapse before the output is sufficient to enable these countries to export to any extent. Another feature deserving of note is the tremendous demand there will be for glass in re-building the devastated areas of the war-stricken countries of Europe.

No Importations from Europe

These appear to me to be the chief factors in considering European supplies. If my observations are correct then it would seem that Canada cannot look for large importations of glass from Europe for quite a long period, which means that it will be necessary to continue to draw your supplies from the United States and Canadian factories.

With regard to prices, I cannot do better than quote for your guidance extracts from a recent address by the sales manager of the largest producer of window glass in the United States. His statement was:

"The combined window glass output of the entire industry for the year 1918 was approximately 275,000,000 sq. ft., as against a production of about twice that amount for 1917. The export demand for the various world's markets was equal to that of the year previous; it would have been much larger if shipping facilities had been more plentiful.

"The year closes with virtually no stock in the possession of the manufacturer and very small stocks located in distributors' warehouses or among the large consumers.

"Conditions are fundamentally sound. The world's markets are all short of stocks. Supplies have been depleted. Active business awaits the American manufacturers in the overseas markets.

"Conditions throughout the home markets are equally promising. After the business interests of this country adjust themselves to a normal peace level, building operations will be resumed, including those that were under way but subsequently deferred as a war measure, as well as new buildings that are badly needed in various sections of the country.

"A careful survey of the situation warrants the belief that after the dull intervening period of readjustment is safely passed, the demand for window glass for all the world's markets will be the greatest in the history of the industry.

"The cost of production continues high. There

*Canadian Manager, Pilkington Brothers, Ltd., Thorold, Ont., before Ontario Hardware Association.

is no recession in the price of labor; fuel or materials. Market prices for glass are firm and unchanged and are ruling on the same level as those existing since last August, when the last price change occurred."

This gentleman's views are also confirmed in a bulletin to the trade, issued by a large firm of glass brokers who are the distributing agents for a number of the smaller manufacturing plants in that country.

Glass Will Cost More

Since the statements to which I have referred were made the skilled glass workers have received a 10 per cent. increase in wages. Glass manufacturers including ourselves have contracted for supplies of materials at high prices. The United States factories will continue on the same basis of output as during 1918, that is 50 per cent. of normal. In the case of our factory in Canada a large number of skilled workers are still in the army, consequently we are operating with a proportion of less efficient men, which, of course, seriously affects our output; materials and coal are contracted for at war-time prices, and there is every sign of the present rates of wages being maintained. You will, therefore, see that glass is going to cost more to manufacture in 1919 than it did in 1918, and as buyers recognized the necessity for the high prices of last year I do not see how their expectations of lower prices this year can be justified.

In conclusion, while it may be that prices have probably now reached the peak, the deduction to be drawn from the conditions, as outlined, is that prices will be maintained at about their present level for some time to come, especially in view of the fact that the stocks in manufacturers' and jobbers' warehouses, generally speaking, are lower than ever before known.

To help you to size up the European situation I may say that it was officially announced last week that the French Government had just placed an order for 10,000,000 ft., that is 100,000 hundred feet boxes, of window glass with the United States manufacturers. From this it looks as though there was little glass making contemplated in Belgium or France in the immediate future.

Association of O.L.S. Annual

Synopsis of proceedings of the Association of Ontario Land Surveyors, at their annual meeting held in Toronto in the 18th, 19th and 20th February, 1919.

Herbert J. Beatty, Pembroke, in the chair.

Tuesday morning, 18th.—During the morning the several standing and special committees of the Association met together and discussed the reports. In the afternoon in the President's address he referred to close of the war and our members who had enlisted for overseas service; to the matter of reconstruction; road building, and various topics of interest to the Association. The reports of the Secretary-Treasurer, Committee on Topographical Surveys, Engineering, were then presented followed by a paper on Right of Way Surveys and descriptions by the E. T. Wilkie; paper on Design of Concrete Arches by W. E. Taylor, and paper on construction and operating of light Railways in France by a returned member, J. H. McKnight of the Canadian Engineers.

Tuesday evening.—The evening session was occupied listening to a paper by A. R. Davis, of Toronto, entitled "Surveyors in Reconstruction," in which he outlined a proposal of soldier settlement on small gar-

den farms within a radius of 50 miles of the larger cities in the Province, and following this a paper was read on the "History of the Madoc Gold Excitement in 1866-67" by C. Fraser Aylsworth.

Wednesday morning, 19th.—Reports of Committees and discussions on such matters as permanent monuments, governing lines, and tariff were discussed following which a talk on "Town Planning" was given by Nolan Cauchon, of Ottawa, illustrated by several pictures showing proposed schemes of improvement in town planning taking advantage of the natural features and comparing them with similar works in Europe and other parts.

Wednesday afternoon.—Was occupied with discussing drainage matters and construction of roads and pavements, both papers bringing out a thorough and interesting discussion on matters touched upon.

Wednesday evening.—The usual informal dinner was held in the Engineers' Club with representatives from sister societies present as the guests of the evening.

Thursday morning.—The convention wound up its proceedings attending to any other unfinished business consisting of discussion on the surveyors tariff, legislation and other matters of interest. The election of officers with the following results:—President, C. Fraser Aylsworth, Madoc; vice-president, T. D. Lemay, Toronto; secretary-treasurer, L. V. Rorke, Toronto; auditors, D. D. James, Toronto, John VanNstrand, Toronto. There were six nominations for the Executive Council of which two are to be elected. This will be by letter ballot before the 1st of April. The members for the Council are as follows:—F. N. Rutherford, St. Catharines, E. T. Wilkie, Toronto, J. J. Newman, Windsor, R. R. Grant, Toronto, J. M. Watson, Orillia, G. A. McCubbin, Chatham.

The annual luncheon for veteran surveyors (meaning those who received their final certificates prior to 1887) was held in the dining room at the Engineers' Club. Nineteen veterans assembled at the luncheon and enjoyed reminiscing their adventures.

All the steel bridges on the St. John Valley Ry. have been completed and the erecting crews of the Canadian Bridge Co. Ltd., have returned to the company's headquarters. The work remaining to be done on the railway in the spring will cost, according to the estimates of Chief Engineer C. O. Foss, about \$100,000. One of the most important pieces of work still unfinished is the widening of the Nerepis bridge embankment, and this, it is announced, will be done by the railways company, as the tenders received were considered too high.

The Toronto branch office of Mussels, Limited, Montreal, is being re-opened at 546 Confederation Life Building, 17 Queen street, East. Mr. Chester F. England will be in charge. Mr. England was connected with Mr. A. C. Douglas on the wheel pit and tunnel contracts for the Electrical Development Co. and the Ontario Power Co., and afterwards joined the staff of Cairnie & St. George, Ltd., road contractors. Latterly he has been with the Foundation Company.

The question of doubling the water supply of Oshawa, Ont., is being discussed. Lake Ontario is the present source, but the bringing of water from Raglan Hills some ten miles to the north is being considered.

Storm Water Outlet, Moore Park, Toronto

Concrete for Sewer Constructed in Tunnel Was Poured
Down Post Holes Bored Through Roadway

DURING the past year the city of Toronto has been installing a drainage scheme to take care of the storm overflow of the Moore Park district, which is situated east of Yonge street, on the height of land to the north of Toronto. This portion of the city comprises about three-eighths of a square mile of wooded land, only portions of which are built up, and of which only a few of the more important streets are paved. The local sewers of this locality are embodied in three systems of combined sanitary and storm-water sewers, the northern portion being served by a 2 ft. 8 in. x 4 ft. egg-shaped sewer emptying into a branch of the Don River, while the drainage of the southern and greater part of Moore Park is taken care of by two main sewers, one following Ridge Drive to the head of Glen Road at the C.P.R. tracks, the other a 4-ft. 6 in. circular brick sewer down Sight Hill Road to the C.P.R. tracks. The outflow of the latter has hitherto been carried by a 15-inch vitrified sewer along Summerhill Ave. to a sewer on MacLennan Ave., but this is at present being picked up and replaced with a 4 ft. 3 in. circular two-ring brick sewer, laid along Summerhill Ave. to connect with the Glen Road trunk, of which this article is essentially a description. The Ridge Drive line connects with the trunk by a 24 in. vitrified sewer down Glen Road, followed by one of brick, 3 ft. 9 in. diameter, along Summerhill Ave. to the junction chamber at Glen Road and Summerhill Avenue. The main unit of this overflow system, located at Glen Road, has been completed within the last year. This is entirely a storm water sewer, weirs at the foot of Sight Hill Road and Ridge Drive deflecting the sanitary flow along separate channels

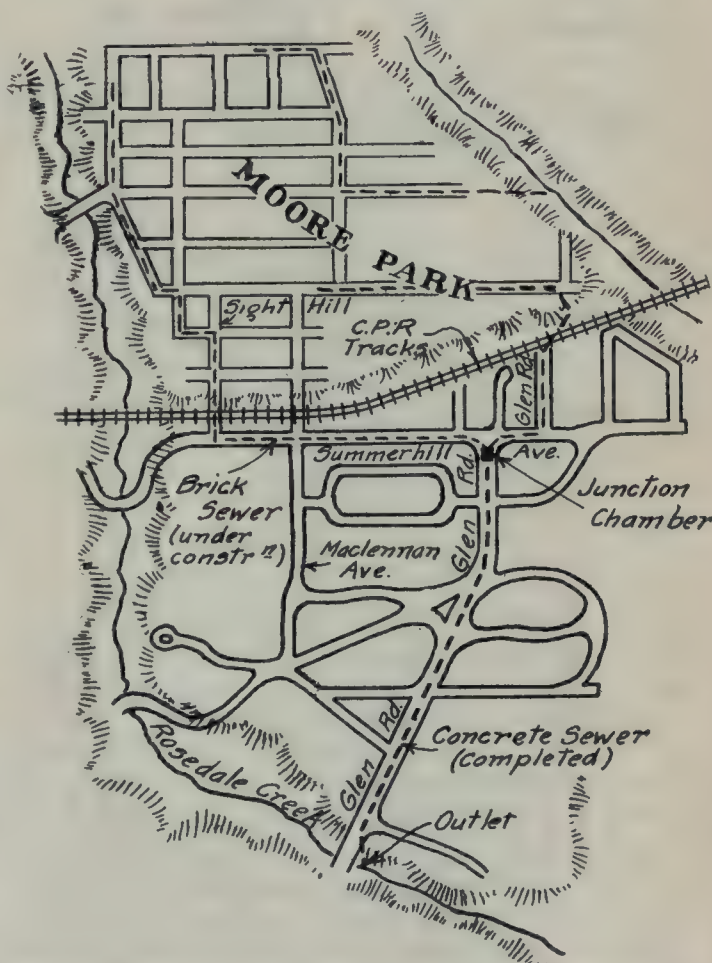
Concrete Sewer Laid in Tunnel.

The Glen Road section of the Moore Park drainage scheme is a concrete sewer of special section laid entirely in tunnel under a covering of 25 ft. or less. The tunnel is 2812.5 ft. long, following the line of Glen Road from Summerhill Ave. to the Rosedale Ravine, where it discharges into the Rosedale Creek. The grade of the sewer is 1 in 110 or 0.91 per cent., except at the outflow, where a steep downhill grade of 1 in 2.7 is followed. The cross-section to which the sewer is designed is a special culvert section, 4 ft. 9 in. in height at the crown, and 4 ft. 3 in. horizontal diameter at the invert, with the profile of the crown walls embodying arcs of three different radii. Nine inches is the minimum wall thickness. The system includes a 15-foot ramp (measured horizontally) to accommodate the grade of the street and having a drop of 12 ft. 8 in. To receive the two branches of the Moore Park scheme previously explained, there is a junction chamber and bell mouth at Summerhill Ave. The outlet of the system is a 24 in. vitrified tile pipe, concrete covered, trenched in the side of the ravine on a grade of 1 in 2.7, discharging through a concrete culvert into the creek. Eight manholes give surface access and provide for laterals if necessary, although they are not contemplated as the sewer serves only for

the Moore Park overflow and not as a receiver for the locality through which it passes.

Methods of Tunneling

As the cover depth reached 25 feet tunnel excavation was most economical. Preliminary borings, eleven in all, indicated a soil at the tunnel level of soft blue clay for the most part, with about 300 ft. each of hard sandy clay and sand. Upon tunnelling there were found a few hundred feet of rather soft filling in a former creek bed, not indicated by the borings. This did not cause trouble, however. The soil was firm enough to dispense with timbering, except crown planks, to protect workmen from the scaling and

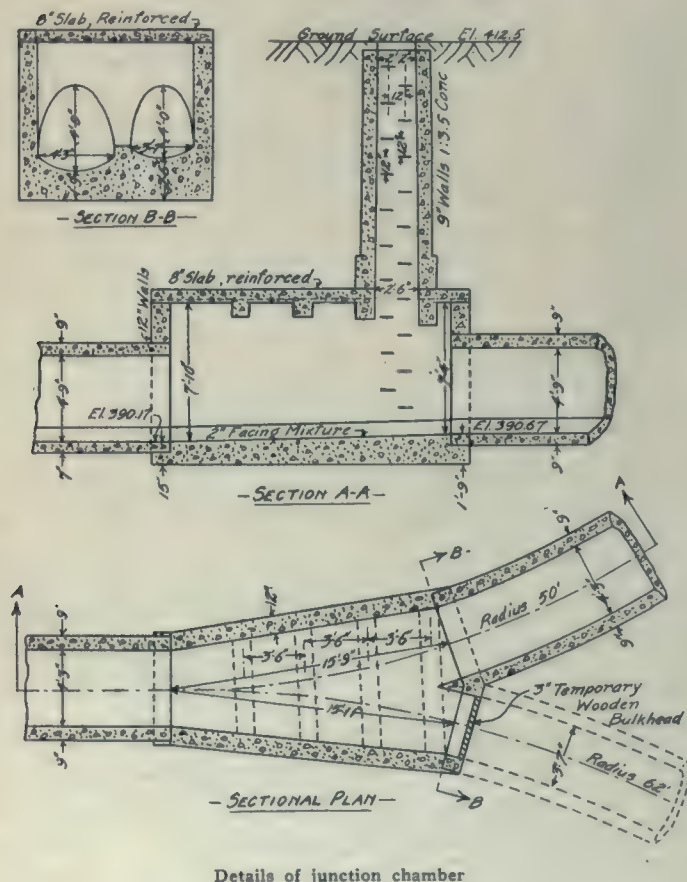


Glen Road Sewer,, described in this article, completes drainage system of Moore Park District

shelling, which were frequent but not detrimental. Six shafts were sunk along Glen Road to the sewer line and tightly lined and braced. The headings were carried each way from the shafts, adjacent headings meeting midway between shafts. The shaft head equipment comprised a timber hoist frame, with inclined trip for dumping the buckets and loading the muck into wagons. One double-drum hoisting engine was arranged to serve two shafts at a time. The trip

comprised an inclined chute built on the hoist-frame with a trap-door which was lifted as the bucket was hoisted and released when it reached its upper limit. Upon dumping the bucket the chute carried the spoil to the wagons.

Two miners and two muckers composed a heading gang and each shaft required, in addition, a signalling man on the hoisting frame, an engineer and a general utility man loading wagons and cleaning up.



The tunnelling was carried out with mattocks and picks, the muck being loaded into buckets and carried to the shaft on 4-wheeled trucks running on steel rails. The buckets were hoisted from the shaft bottom and dumped on the inclined trip into wagons.

About 8 ft. per day was the average heading progress. The concreting gang installed a section of pipe as soon as the tunnel was bored, the mining being usually done by day shift, with concreting following at night, though occasionally, the reverse procedure was carried out. Four headings were usually active at the same time and an extra gang was always busy sinking one shaft ahead of the work in hand to ensure work for the heading crews.

Concrete Poured Through Post Holes in Roadway

The forms were wood, built in 8-foot lengths. They were more or less complicated by the cross-section of the tunnel, which was designed to arcs of three radii. To avoid confusion of the lagging for each of these circles, the units for each were cleated together with iron straps. In resetting they were thus easily sorted and arranged. Concreting was carried on in 8-foot sections, but if the soil was good enough to allow boring at greater speed than 8 ft. per shift, half forms

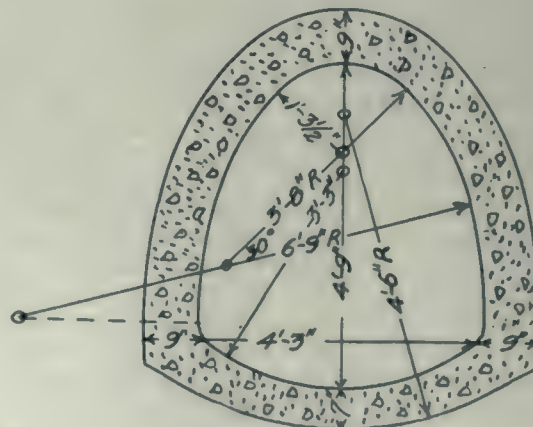
were provided to enable 4-foot sections to be poured if necessary.

Concreting was carried out in a rather novel manner. Owing to the lack of space in the tunnel, it was decided not to pour in the conventional way from the tunnel by erecting forms little by little and placing the concrete simultaneously. The crown section would have caused difficulty and extra labor would have been involved in transporting concrete from the shaft to the heading. The contractors in view of this condition, bored post holes through the roadway directly to the sewer tunnel, each hole being in the centre of an 8-foot section. The forms were erected completely, the open end bulkheaded and the concrete mixed at the surface of the road and poured through the post holes. With a rather soft mixture this scheme worked admirably and the pressure behind the concrete was sufficient to eliminate all voids. When the pouring was complete the post holes were filled with concrete and resurfaced with asphalt. The crown walls were poured before the invert, this being afterwards concreted and keyed to the sides. A portable Foote gasoline batch mixer was used for the manufacture of concrete. The mixture was 1:3:5, with 1 in. crushed stone.

The entire job was carried out in winter weather. This necessitated the heating of the supplies by means of steam coils. Owing to the impossibility of obtaining sand and stone by rail from outside pits, the contractors had to haul these materials by sleigh from pits at East York.

Ramp and Junction Chamber

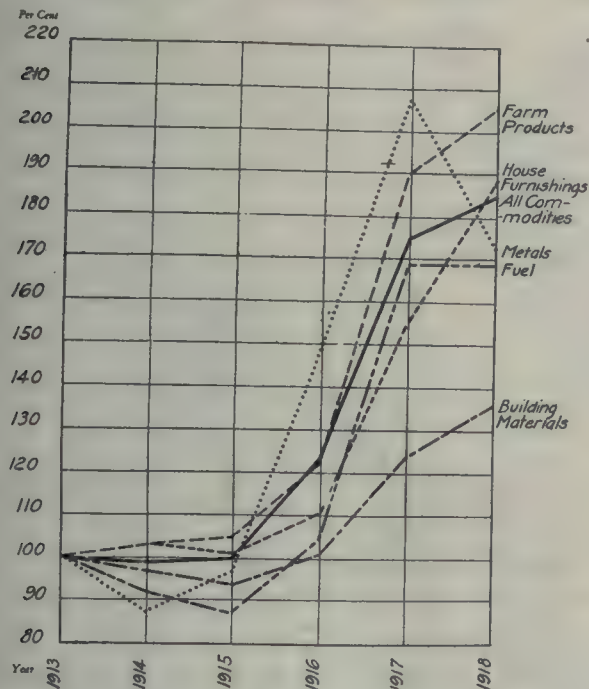
The ramp, previously mentioned, has a horizontal length of 15 ft. and a drop 12 ft. 8 in. While the original design called for concrete, the difficulty of placing forms and reinforcing in tunnel made it advisable to build the ramp of brick. The junction chamber, comprising a "Y" connection and bell mouth, was constructed in open cut. The design is an 8 in. slab on reinforced concrete beams. The outlet consists of an 80-foot drop, approximately, through a 24 in. tile pipe encased in concrete and resting on concrete saddles, connecting with a 3 ft. x 3 ft. 1½ in. culvert, discharging into the creek at the ravine bottom.



The entire work was initiated by the sewer section of the Department of Works, of which Mr. W. R. Worthington is chief assistant engineer and Mr. W. G. Cameron, engineer of maintenance and construction. The contractors were the Godson Contracting Co., H. F. Barker, engineer.

"Now" is a Good Time to Build

THE accompanying chart was prepared by the Portland Cement Association on data supplied by the U. S. Department of Labor. It shows that building materials, by comparison with products of agriculture, mines and industry, are not high priced, and that now is a very favorable time to



The increase in cost of building materials is much less than that of other commodities

exchange these products for building. Taking the level of prices as 100 on Jan. 1, 1913, building materials in five years following show an advance of about 35 per cent., while the products of agriculture, mines and industry, show an advance ranging from about 70 to 105 per cent.

List of Government Employment Offices

The Dominion Government has now compiled the list of Provincial Employment Offices where returned men who are desirous of obtaining employment will register and where employers of labor may get in touch, either by correspondence or in person, with the type of labor they require. There are already some seventy-six in all located as follows:

Employment Offices Reported to be Operating at Present

Ontario

Toronto	43 King St. W.
Toronto	72 Front St.
Ottawa	139 Queen St.
London	108 Dundas St.
Hamilton	87 Jones St.
Port Arthur	193 Park St.
Fort William	300 Victoria Ave.
Kingston	22 Market St.
Sudbury	Station St.
Brantford	136 Dalhousie St.
Peterboro	190 Charlotte St.
Sault Ste. Marie	349 Queen St. E.
St. Catharines	St. James St.

Manitoba

Winnipeg	216 Bannatyne St.
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Saskatchewan

Regina	1641 Broad St.
Moose Jaw	18 High St. E.
Saskatoon	Connaught Bldg.
Yorkton	
Weyburn	
Prince Albert	Masonic Temple
Swift Current	

Alberta

Calgary	Beveridge Bldg.
Edmonton	10220 1st St.
Lethbridge	Hull Block
Medicine Hat	Quebec Bank Bldg.
Red Deer	17 Ross St. W.

British Columbia

Vancouver	Cordova St. W.
Vancouver	Homer St.
Vancouver	Dunsmuir St.
Victoria	Cor. Langley and Broughton Sts.

Quebec

Montreal	8 St. James St.
Quebec	83 Dupont St.
Sherbrooke	18 King St.

Proposed Employment Offices

Ontario

St. Thomas (Employment Service & S. C. R. Dept.)	
Kitchener	
Chatham	
Galt (Employment Service & S. C. R. Dept.)	
Guelph	
Windsor	
Stratford	

Manitoba

Brandon	Dauphin
The Pas	Portage la Prairie

British Columbia

Prince Rupert	New Westminster
Nelson	Nanaimo
Cranbrook	Fernie
Kamloops	

Part Time Offices

Prince George	Revelstoke
Rossland	Trail
Grand Forks	Vernon
Kelowna	Merritt
Chilliwack	

Quebec

Three Rivers	Chicoutimi
St. Hyacinthe	Hull

New Brunswick

St. John	Fredericton
Moncton	Bathurst

Nova Scotia

Halifax	Amherst
Sydney	New Glasgow
Yarmouth or Kentville	

Prince Edward Island

Charlottetown	
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The Suburban Road Commission of the city of Guelph and the county of Wellington, Ont., propose an expenditure of \$10,100 this year—\$5,000 for road machinery, \$600 for bridge construction and \$4,500 for repairs.

Payment for Estimating is Coming

Free Preparation of Estimates is an Evil that Should be Overcome—Suggested Remedial Measures

By L. A. Griffin*

IT is not yet time for action on the subject of demanding payment for estimating, though it is no present violation of confidence to say that we are not far from the beginning of real action. The subject is a big one, in fact, it may be possible that it is the one vital subject before the contractor to-day.

It also happens that in discussing it one must go over ground that has previously been covered. But that is no real drawback. Frequent statement of the same correct proposition is often necessary in order that the truth of it may be driven home to those who, in the beginning, are slow to see its merits and its truth. With me the matter is not a mercenary one, by which I mean that my motives are not at all mercenary. Those who have read my former contributions on the subject will readily understand what I mean when I say that there is really no such thing as an estimate that is furnished free. Somebody pays for it without knowing it, but, just the same, he pays.

It is a great pleasure to me to know that the men who are engaged in the contracting business are 100 per cent in favor of some plan that will carry out the ideas I have attempted to present in these columns. We may differ as to the proper methods, but we are agreed that some way or another we must get to a common point and do away with the non-remunerative work which every one of us has done at some time or another, and, many of us, very much of the time.

What we want, and what we must have, is a safe, sane and conservative method. No one of us. I am sure, wants more than that; no one of us, it is safe to assert, will be satisfied with less. No one will make any very serious effort to deprive us of that to which we are entitled so long as it is understood that we are not trying to get more than our just dues.

Attempting to Solve the Problem

Nor is it at all pretended that we are the pioneers in this movement. The National Contractors' Association is working out, or endeavoring to work out, this very scheme, and is going about it in a manner which indicates that its officers intend to find a solution if such a thing is possible. But that need not prevent our Association from going ahead and using the big amount of talent it has at its command among its membership to work out a real working plan which in the end will result in an absolutely fair deal to all our members and to every one of their patrons as well.

Our Association has appointed a representative and highly intelligent committee to investigate the plan and to formulate a system which will be perfectly fair to the contractor and to the man who pays the bills. I have great faith in that committee. I believe that its members are possessed of the ability to formulate and present to our members something that will be workable and which will be entirely satisfactory to every man with whom we will do business. And I want to impress upon every one of my readers the important fact that we are not trying to put over something

which will give us that which we do not earn. I want to have it distinctly understood that we do not want anything that does not belong to us. We believe in a "world safe for democracy," which belief compels us to champion nothing that does not spell absolute fairness for every one who is a part and parcel of a democracy.

When the report of our committee is presented it will, I am sure, be found to contain nothing to which any fair-minded man can object. It will show that the subject has been carefully considered, that many suggestions have been digested, and that while the plan presented may not be perfect, it is a long step in advance and therefore worthy of more than passing notice.

Quantity Surveying

There have been presented three distinct and different methods of doing away with the evil of free estimating, and, if you will but stop to think of it, free estimating is the giving away of time and talent. You do not do that sort of foolish thing in the actual work of building. Then why do it in the work of preparing to get the opportunity to do the building? One method in the line of reform is the so-called quantity survey which has been discussed quite freely, but which, despite the merits claimed for it by its advocates, has not come to the front in this country. Perhaps it lacks the very things we most desire. I would not want to even appear to be throwing cold water on the idea, for it is but an effort in harmony with the one we are getting ready to make, and for that reason should be entitled to thorough discussion. One reason why I cannot endorse it is that the quantities are furnished by the owner, or the engineer, or the architect. Now, if one or the other of these should desire to play sharp practice on the contractor, he could put the quantities in such a way that they would be misconstrued because of the nature and openings of the work. So the unscrupulous would order the surveyor to tighten up on places where he could do so. That, to be sure, would depend on what manner of man he was, though it would be quite natural for the surveyor to favor the man who gave him the job, hence gave him his bread and butter.

Next, in order to check on the quantities it is necessary for the contractor to go over the plans and specifications, in order to verify all the quantities, so I do not see that there is very much of a help to the contractor there in the way of relieving him from work for which he is not paid. And it is possible that it would put more contractors into the field. God knows we have enough now of the kind who do not know how to figure work nor how to do it after they have been awarded it. The method under discussion would enable them to butt in and take a chance on the presumption that it could be followed as to bidding without going to the trouble of applying real contracting intelligence and checking the estimated quantities with the plans and specifications.

We now come to the plan of the National Contractors' Association. It, to my mind, comes near to the

*Paper read before the Masons' and Contractors' Association of the United States and Canada.

solution of our problems. But it has the inherent weakness that too much depends upon the fellow who handles the bidding. If he should prove to be a man beyond the reach of temptation then no harm could come to anyone. But if such person should happen to be a grafter then there is no way of getting at the harm he could do all the reputable contractors who did not fall for his way of doing things. Or, he could double cross them without their knowing it.

The Nelson Plan comes nearer to what I consider correct practice. With it in use there is no middle man. Bids are invited openly and from just as many contractors as the prospective bidder is willing to pay for estimating. I am speaking now of private work. In the case of public work there would have to be devised some method of limiting the number of bidders, or, in many cases, the cost of estimating would be greater than the cost of the work—a condition that, of course, should never be allowed to arise. Mr. Nelson is modest and declares that he does not insist that his plan is perfect. But it is a plan, it is worked out clear to the end, and no detail appears to have been overlooked. He is entitled to more than praise for his efforts. One of his rewards should be that many local associations either try his plan, or his modifications of it, with which a committee of the Mason Contractors' Association of the United States and Canada is now wrestling. It may be possible that the committee will improve upon the Nelson Plan. Again, it may find that the Nelson Plan is what ought to be tried by all our members.

I sincerely trust that all our members will, when they get the report of our committee, give it the attention to which it is entitled. And when we have finally agreed upon a plan of action let us all get together and pull together, and not only do ourselves some material good, but put the matter of estimating on the high plane where it belongs and free it from the lack of business sense which has scandalized it altogether too many years.

Optimistic Spirit is Justified

AT the recent convention of the Retail Hardware Merchants' Association, held in Hamilton, Mr. R. H. Falkiner, of the Allith Manufacturing Co., addressed the members on the subject of "Optimism." He said:

I think it is the duty of everyone present to do their utmost to create this spirit for the betterment and development of this fair Dominion of ours.

Personally, I am in touch with the building situation generally, as well, if not better than anyone in this room, and it is extremely encouraging for me to note the increasing relief from the depression that has prevailed during the period of the war.

Gentlemen, we are on the verge of a crisis which we have never experienced before in the Dominion of Canada, the problem of repatriation and reconstruction. As an evidence of the government's appreciation of the critical situation, they have placed themselves on record as being most decidedly in favor of spending huge sums of money in necessary public improvements. They have also gone further than this, inasmuch as they have recommended strongly to our various municipalities that they undertake similar programmes.

Recently my belief in the near approach of a most progressive era has been considerably increased by a request made to me that I arrange to undertake a trip to Europe in the interests of the Canadian builders' hardware manufacturing firms, with the idea of securing a share of the continental business. It is reasonable to expect that Canada will undoubtedly secure her share of this trade. This predicts activity in the Canadian industrial world, and with this assurance, good times cannot fail to be reflected in the industrial life throughout Canada. It will naturally follow that this will create new business for everyone in their line of endeavor and help solve our problem for the unemployed. The outstanding benefit to Canada from the heroic record of the Canadian Expeditionary Force is recognized in the birth of Canada as a nation. This has been established the whole world over, and it is our duty, gentlemen, as Canadian citizens, to keep Canada before the world in order to obtain full benefit from the achievements of our fighting troops. This, to my mind, can be achieved in no better way than by a continuous aggressive campaign in developing the "Made in Canada" idea. Germany's commercial supremacy was, to a large extent, due to their efforts along these lines. Be patriotic, gentlemen—"Buy Canadian-made products," which will enable the Canadian manufacturers to increase their plants and staff to such an extent that we shall be in a position to supply your needs at all times. Canadians have shown that they can "go over the top" and do things, and I claim that if we have our returned men placed under capable foremen and instructors in our plants, we can make them skilled workmen, second to none, under proper technical and practical training.

Imperial Trading Company

Further evidence of deep faith in the future of Canada and Canadian commerce is furnished by another new company, recently formed, the Imperial Trading Company, with head offices at the Herald Building, Montreal. This company intends to deal in iron, steel, copper, brass, lead, spelter, and other metals; in rails, railway equipment; motors, generators, transformers, and machine shop tools; wool felt, cotton waste and other textile products, also pulp mill and mining machinery.

The company is also negotiating for a number of sole agencies for Canada, of important products from the Orient, including China, Japan, East Indies, Malay States, India, Ceylon, Indo-China, Straits Settlements, etc.

The president is Major G. A. E. Bury, son of Sir George Bury. Major Bury, before joining the overseas forces, was a prominent barrister in Winnipeg. He returned to Canada recently after over three years with the Canadian Expeditionary Force. He is a graduate of the University of Manitoba.

The vice-president and general manager is Mr. E. C. Peterson, formerly district manager of the Northern Electric Company, Limited. Prior to that he was in charge of the Production Department of the Western Electric Company, Chicago, with which he began his business career in September, 1899, immediately after graduating from the Iowa State College, both in Mechanical and Electrical Engineering, receiving the degree, B. Sc.

Tests on Cement Gun Products

By Mr. Bryan C. Collier *

CARL E. AKELEY, in 1907, conceived the idea that by the introduction of the water or hydrating medium, into the cementitious material, coincidentally with the deposit he could prevent setting or hardening of the mortar before its application. Inasmuch as his work demanded so continuously the use of gypsum with its quick-setting tendencies, he saw more clearly than the average engineer the absolute necessity for this. He, therefore, conceived the idea of introducing the water into a chamber nozzle through which the dry and previously mixed material should be forced by compressed air, and on this principle the machine is based.

His experimentation, carried on over a period of several years, showed the further advisability of dividing the materials into small amounts in order to prevent the clogging due to the introduction of too much material into the hose at one time. This resulted in the development of a method of "feed" by means of pockets in the periphery of a revolving wheel which allowed the intermittent action necessary from this viewpoint.

The third governing principle of this machine is that of the locking and working chamber of a caisson, which thus accomplishes the result of continuous operation, as the working or discharge chamber is always under pressure, the supply material being introduced through the upper chambers.

The cement gun means several things to the engineer:

1. That by its use methods of construction can be developed that will eliminate to a large extent the use of forms, and for those forms or panels that are necessary we need not provide the excessively heavy bracing needed to withstand hydrostatic heads, as is the case with poured concrete.

2. The material produced is infinitely stronger in all tests than any concrete or hand-placed mortar yet produced, thereby permitting a reduction of sections to a very considerable extent.

3. By its use the demarkation line between work previously placed, which is such an objectionable feature in poured concrete, is eliminated. It has been definitely proved that the joint between new and old sections of Gunitite is as strong as the Gunitite itself, and between old concrete and Gunitite, stronger than the concrete. An interesting proof of this was developed in Arizona about a year ago. A concrete girder was poured and allowed to cure for several days, after which a Gunitite knob was shot on the side of this girder, the surface having previously been cleaned and wetted. The top of this knob was smoothed off to act as the seat of a fulcrum, and leverage was applied sufficiently to break down the section. Instead of the break occurring along the cleavage line between the Gunitite and concrete, the fracture took place within the poured concrete.

Tests have recently been made by Prof. McKibben of Lehigh University to determine the modulus of rupture of Gunitite, and his report shows results on slabs shot as follows:

C.	Shot horizontally, four layers, 1 in. each, 1-hour intervals....	13
D.	Shot horizontally, four layers, 1 in. each, 4-hour intervals....	13
E.	Shot horizontally, four layers, 1 in. each, 24-hour intervals....	13
F.	Shot vertically at one operation, 4 in. thick.....	13
G.	Shot vertically, four layers, 1 in. each, 1-hour intervals....	13
H.	Shot vertically, four layers, 1 in. each, 4-hour intervals....	13
J.	Shot vertically, four layers, 1 in. each, 24-hour intervals....	13
K.	Shot vertically at one operation, 4 in. thick.....	14
L.	Shot vertically, four layers, 1 in. each, 4-hour intervals....	14

It was the original intention in making these tests to get the modulus of rupture on samples A, B, C, D and E only, and, therefore, provision was made to eliminate the possibility of weak material along the corners of the forms. It was further intended to use the slabs that were shot against vertical forms to make compression tests. It was found, however, that the Gunitite was so hard that the ordinary cutting machines would not suffice to cut it into cubes, and so it was decided to use these slabs for additional rupture tests. It will be noted from the following tests that these slabs did not show as good results as did the horizontally shot samples, and as all other evidence warrants the belief that vertically-shot Gunitite is slightly stronger than that shot horizontally, the assumption has been drawn that the "weak" corners which were included in the area were responsible.

Modulus of Rupture.

	28 Days.	90 Days.
A	617 average of 3 samples.	643 average of 3 samples.
B	445 average of 2 samples.	802 average of 2 samples.
C	384 average of 3 samples.	746 average of 4 samples.
D	355 average of 3 samples.	621 average of 3 samples.
E	210 average of 3 samples.	308 average of 3 samples.
F		581
G		494
H		550
J		598
K		689
L		590

These results were obtained by placing a knife-edge load on the center of each slab which was supported on knife-edge supports, and the notation is made, "Every slab failed by breaking practically straight across the center of the span."

All of these slabs were shot from bank sand having an average moisture content of 5.26%. The mechanical analysis showed 73 per cent. passing a No. 10 sieve, 25 per cent. passing a No. 40 sieve, and 2.3 per cent. passing a No. 100 sieve. The cement was a standard brand of "Valley" cement. Tensile tests made on hand-made briquettes of this cement and sand, mixed 1 to 3, gave an average tensile strength of 142 lb. per sq. in. Other interesting data gathered from these tests show:

1. That to 652 cu. ft. of dry mixed sand and cement fed to the Gun was added 71 cu. ft. of water.
2. The percentage of dry material to completed Gunitite averaged about 50%.
3. The percentage of sand rebound was about 15 to 20%.
4. The voids in the sand averaged 40.7.

An analysis of these statements shows that the reduction in volume is evidently due to the absolute filling of all voids.

Tests were made on the total absorption of Gunitite 28 days old; samples taken from Slab B showed 4.2%; Slab C, 3.7%; and Slab D, 5.5%.

At about the same time that these tests were being made by Prof. McKibben, the U. S. Shipping Board, in co-operation with the Bureau of Standards, began a very exhaustive set of tests to show the compressive

A.	Shot horizontally at one operation, 2 in. thick	Mixture 1.3
B.	Shot horizontally at one operation, 4 in. thick	1.3

* Before the Municipal Engineers' Society.

strength and modulus of elasticity of Gunite. The engineers of the Board experienced the same difficulty as did Prof. McKibben in cutting the samples into testing prisms, but as the facilities offered by the Bureau were so extensive they were able to complete an extensive program of tests, although they were able to get 28-day tests on only a few samples. These few tests showed that there was a very much smaller proportion of increase between the 28-day tests and the 90-day tests than is usually the case with concrete. The figures herein quoted will apply to tests made on samples 90 days old or slightly older.

There were a total of 384 prisms tested and an analysis of the results produces some very interesting data; 204 of these prisms were shot against both vertical and horizontal surfaces with different proportions of mortar, and under other varying conditions. All samples were tested with the breaking load applied both perpendicularly to the plane of the applied layers, and also parallel with these planes.

The average ultimate compressive strength of all of these 204 prisms was:

Tested perpendicularly 4470 lb. per sq. in.
Tested parallel 4258 lb. per sq. in.

The other 180 prisms were shot through heavy screens of reinforcing, the object being to determine the strength of Gunite behind the reinforcing bars. These samples, shot against both horizontal and vertical surfaces, showed a strength of:

Tested perpendicularly . . .4311 lb. per sq. in.
Tested parallel 4531 lb. per sq. in.

Of the 180 prisms, 21 of these were shot against horizontal surfaces and showed:

Tested perpendicularly . . .4724 lb. per sq. in.
Tested parallel 4521 lb. per sq. in.

One hundred and fifty-nine were shot against vertical surfaces with results:

Tested perpendicularly . . .4291 lb. per sq. in.
Tested parallel 4532 lb. per sq. in.

There were 15 prisms shot against vertical surfaces, which showed an average of only:

Tested perpendicularly . . .2796 lb. per sq. in.
Tested parallel 3293 lb. per sq. in.

which the author was requested not to consider in the above averages, as there was some evidence of mistake or irregularity.

Of the 204 prisms above referred to, 168 were shot against vertical surfaces, and the average of these samples showed:

Tested perpendicularly . . .4500 lb. per sq. in.
Tested parallel 4283 lb. per sq. in.

The other 36 prisms were shot against horizontal surfaces with the result of an average:

Tested perpendicularly . . .4345 lb. per sq. in.
Tested parallel 4142 lb. per sq. in.

In this case it is noted that the samples tested perpendicularly showed more strength, which is what is to be expected, when it is recalled that the layer or film of dust that settles on a horizontal surface precluded a perfect adhesion between the various layers, but even this difference is so slight as not to be reckoned with.

A further analysis will show results that are of still greater interest and benefit in determining what can be done with the material in actual practice. Although it is not considered good practice ordinarily to place as heavy a layer as 6 in. of Gunite at one operation, due to the tendency of gravity to break it down, still

this was done in these tests, and the results of 18 prisms shot against a vertical surface showed:

Tested perpendicularly . . .4631 lb. per sq. in.
Tested parallel 4490 lb. per sq. in.

48 prisms were shot against vertical surfaces in three layers of 2 in. each at varying intervals, and the results were:

Tested perpendicularly . . .4454 lb. per sq. in.
Tested parallel 4073 lb. per sq. in.

102 prisms were shot against vertical surfaces in six layers of 1 in. each, at varying intervals, and the test showed:

Tested perpendicularly . . .4492 lb. per sq. in.
Tested parallel 4336 lb. per sq. in.

It will be of interest to compare the two last referred to results. The results of the six layers showed that the strength of the sections were practically identical each way, while the results from the three layers showed a difference in favor of the samples tested perpendicularly. Of the samples tested, however, about half showed a greater strength under parallel testing, which offsets any predisposition to suppose that these results are an evidence of weakness.

Of the samples shot against horizontal surfaces 15 were shot in a single operation, or 6 in. thick. They resulted:

Tested perpendicularly . . .4470 lb. per sq. in.
Tested parallel 3928 lb. per sq. in.

18 prisms were shot in three layers of 2 in. each, and showed:

Tested perpendicularly . . .4090 lb. per sq. in.
Tested parallel 4123 lb. per sq. in.

Only 3 prisms were shot in six layers of 1 in. each, with results:

Tested perpendicularly . . .5250 lb. per sq. in.
Tested parallel 5320 lb. per sq. in.

In making a further analysis, it is interesting to develop the fact that the difference in intervals between layers of Gunite when properly applied against surface that have been thoroughly wetted, produces very little variation in strength. This substantiates the opinion of many engineers that the adhesion between new and old surfaces is perfect.

Six of the vertical prisms were shot with 1 to 3 mixture in three layers with 72 hours intervening. They showed a strength:

Tested perpendicularly . . .3755 lb. per sq. in.
Tested parallel 3485 lb. per sq. in.

Inasmuch as most of the samples discussed above were shot at 24-hour intervals, the comparison is apparent.

It developed in this work that rich mixtures under normal treatment developed shrinkage cracks.

Forty-five prisms shot vertically with a mixture of 1 part cement and 2 parts sand (or aggregate) resulted:

Tested perpendicularly . . .4819 lb. per sq. in.
Tested parallel 4652 lb. per sq. in.

while with a mixture of 1 to 2½ six samples showed:

Tested perpendicularly . . .4783 lb. per sq. in.
Tested parallel 4500 lb. per sq. in.

On the other hand the 1 to 3 mortar showed in 105 prisms a test of:

Tested perpendicularly . . .4266 lb. per sq. in.
Tested parallel 4006 lb. per sq. in.

It would, therefore, seem that the most advantageous mixtures are 1 to 2½ for work demanding high water resisting qualities and 1 to 3 ordinarily conditions.

Some samples were developed with the use of ag-

gregate ranging up to $\frac{1}{2}$ -in., on the assumption that the larger materials would show greater strength, as is the case with concrete. As the work progressed, the results showed that there was no advantage, and that a well-graded mixture, $\frac{1}{4}$ -in. and under, best satisfied all conditions.

A study of these results will show that a safe assumption for 1 to $2\frac{1}{2}$ Gunitite will be 4,500 lb. per sq. in. ultimate compressive strength, and for 1 to 3 Gunitite 4,000 lb. per sq. in. When this is compared with tests made on concrete at different places, and under different conditions, the apparent advantages offered are seen at once. For example, Prof. D. A. Abrams, in his recent paper before the American Society for Testing Materials, showed that he had obtained an average of 3,038 lb. on 1 to 3 concretes. The often-referred-to tests, made at Watertown Arsenal for the Boston Elevated Railroad in 1899, showed an average of 2,944 lb. at the end of three months on 1:2:4 concrete. A comparison also was made during the progress of these tests between hand-placed concrete and Gunitite of the same materials, and in nearly every case the Gunitite was about 30% stronger than the concrete. This means that if we work with the safe load factor of 3, as is now recommended by some authorities, we will assume a compressive stress in 1:2:4 concrete of about 1,000 lb. against 1 to 3 Gunitite of about 1,350 lb. or in 1 to $2\frac{1}{2}$ Gunitite of 1,500 lb.

In developing the modulus of elasticity, it was not possible to test as many samples as for compression, but the results obtained were highly instructive and beneficial:

Three prisms were made of 1 to 2 Gunitite and showed an average modulus at 90 days of 5,417,000 lb.

Two of 1 to $2\frac{1}{2}$ Gunitite were tested at 90 days and showed an average of 4,760,000 lb.

Eight tests were made on prisms of 1 to 3 Gunitite with an average result of 4,705,000 lb.

Recent specifications, published by the U. S. Navy Department, give the safe ratio between the modulus of elasticity of steel and the best 1:2:4 concrete at 12 while these results will show a safe ratio of $6\frac{1}{2}$, which, of course, means that a very much higher stress can be thrown on the steel before the Gunitite begins to show hair cracks.

Asphalt Shingle and Prepared Roofing

By Mr. E. T. Bush*

THERE are more than seven companies in the Dominion of Canada engaged in the manufacture of asphalt shingle and prepared roofing at the present time. These mills, with their allied interests, represent an investment of several millions of dollars.

Daily Production

The most conservative estimates place the present daily output of this industry at approximately 700,000 square feet of finished material. The increasing demand is rapidly forcing a greater production, so that these figures will soon be increased on account of export trade to foreign countries.

The Universal Roofings

This vast output is shipped to all parts of the Dominion. During the war large quantities were ordered by the allied governments and shipped to England,

France, Italy, Russia and Belgium, for barracks, hospitals, etc. This has created a demand for this class of material from foreign countries. In the Dominion of Canada there is probably not a single community where buildings are not protected with asphalt shingles or prepared roofings. Factories, mills, warehouses, railroad terminals, business blocks, churches, school houses, costly residences, modest cottages, and farm buildings, are roofed with either asphalt shingles or prepared roofing, which make them the universal roofings.

Satisfactory Service for Twenty Years

No thoughtful person can remain indifferent to these facts. They demand attention. The increasing demand is the result of satisfactory service. When a man roofs his new house with the same kind of material he has used fifteen or twenty years before, it does not take an expert to discover the reason. The tremendous growth of the prepared roofing business during the past twenty years is due to satisfied customers.

Satisfied customers are powerful factors in the development of any business. No industry, however well equipped and financed, can permanently remain upon a staple basis unless it is engaged in the manufacture of a commodity by the right economic principles that compel success. Such a commodity is an economic necessity.

Asphalt shingles and prepared roofing come under this head, not only because of the satisfied customers, but in the fact that they meet all the requirements of a roofing which is fire resisting, superior, and at a lower cost than any competing material on the market. These are profound facts, yet easily understood if we consider the many materials which were in great demand at one time, and have now been forced into discard as the result of the discovery or invention of new materials which has replaced them at a lower cost.

Wood Shingles

Several years ago wooden shingles were an economic necessity, because they were used as no other available roofing material could be obtained at a moderate price. There were but few congested districts such as we are now confronted with in our cities and towns, and the inflammability of the wooden shingle was not so important as it is to-day. With the increasing population, and general destruction of the forests, came an increase in the cost of shingles. The production has been decreasing in many localities until at the present time approximately seventy per cent. of all wooden shingles are produced in British Columbia. The cost of transportation increases the manufacturer's cost at least one hundred per cent. The greatest objection to the use of wooden shingles, are their inflammability and higher insurance rates. The durability of the wooden shingle, is seldom, if ever, guaranteed by the manufacturer.

Felt Base—Saturating and Coating

The real life of prepared roofing depends upon the saturation and coating compounds. They are made from a strong long-fibred felt which has unusually high absorbent qualities, so as to absorb and retain the maximum amount of asphalt waterproofing saturation. Once thoroughly impregnated with the asphaltic saturating compound the felt is permanently protected against moisture and decay.

The saturated felt then receives an extra coating

*Representing Bird & Son, Hamilton, before Ontario Retail Hardware Association.

of a hard blend of asphalt which completes the finished product, and as it does not absorb moisture, it is practically impervious to rain, sleet or snow.

Asphalt shingles and slate surface roofings are the roofing development of the twentieth century.

They are made from the strong long fibred felt, which is the same base as prepared roofing. The felt is thoroughly saturated and also receives an extra heavy coating of a hard blend of asphalt, into which is embedded, under tremendous pressure, a crushed slate surface of red or green in natural colors.

This slate surface is practically impervious to rain, sleet or snow, fire resisting, and does not need any painting, the natural colors (red or green) being permanent, the initial cost being the only expense for many years of service.

Asphalt shingles will not split or crack. There is no tendency whatever for properly applied shingles to curl. They lay flat and adhere to the roof, and as they do not absorb moisture or shrink, it is a chemical and physical impossibility for them to curl.

Durability

The first question invariably asked by the prospective purchaser of roofing is, "How long will it wear?" He is most interested in its durability, which really means the length of time it will withstand the attacks of the elements of the weather, and continue to perform its chief function of remaining waterproof in all climates. Many roofs covered with prepared roofing applied over twenty years are still in service and retain their waterproofing properties.

The services which these roofs have rendered in the past is the best evidence of their durability to withstand all climatic conditions of the atmosphere.

Adaptability

Asphalt shingles and prepared roofing are pliable and can be made to conform to any roof of irregular design, or can be bent over hips and ridges, in valleys, flash against chimneys, walls, etc., which is a saving to the purchaser, and making it unnecessary to use metal flashing, or expensive hip or ridge rolls.

Fire Protection Reduces Insurance Rates

The ability of asphalt shingles and prepared roofings as a protection against fire are greater than the average person realizes, as they do not support their own combustion.

Accepted and approved by the National Board of Fire Underwriters as non-combustible they take the same rate of insurance as slate, metal and tile. Every new roof of non-combustible material helps to reduce the insurance rates; the saving has been as high as 33 1/3 per cent.

Concrete Walls Shot With Cement Gun

ABOUT 40,000 sq. ft. of 2-in. concrete wall were shot with a cement gun on three wooden mine buildings at Victor, Col. The workers used both swinging and stationary scaffolds, and maintained a daily average of 750 sq. ft. with one gun.

After the buildings had been stripped to the bare frames there was nailed to them triangular wire mesh in rolls 50 in. wide by 150 ft. long. On the outside of the wire were placed unit forms 3 ft. wide by 16 ft. long, consisting of three horizontal layers of wall sections made of 2 x 4-in. pieces, nailed to one another and to the framework and wired at the top to the studding. Forms were backed by 3/8-in. cedar lag-

ging, and were removed 12 to 24 hr. after concrete was shot.

The 1 : 3 1/2 concrete was first shot from the inside of the forms for a thickness of 1 1/2 in., air being applied at the rate of about 175 cu. ft. per minute, with a pressure on the gun of 45 lb. and water pressure at 60 lb. Forms were then removed and the concrete shot from the outside to a final thickness of 2 in. The concrete was drawn into the gun from a hopper into which it had been shovelled after being turned once and thrown over a 3/8-in. screen. The best results were obtained by shooting directly at right angles. It was estimated that 7 to 35 per cent. of concrete that fell as rebound was taken up and shot again. After application the concrete was wetted several times in the course of two or three days, and that which was already in place was thoroughly washed before receiving the final layer.—Contracting.

Employers and Employees Get Together

With the object of bringing the big employers of labor and the employes closer together, to study the problem of unemployment, high cost of living and other questions pertaining to readjustment, arrangements are being made to hold a series of get-together conferences in Hamilton, Ont., at an early date. In connection with the movement, which is being pushed by leaders of the Manufacturers' Association, as well as labor leaders in Hamilton, Prof. McIvor, of the staff of the University of Toronto; S. R. Parsons, past president of the Canadian Manufacturers' Association; and Sir John Willison, of Toronto, president of the Canadian Industrial Reconstruction Association; will be asked to speak at public meetings.

One of the results of the informal conferences held this week between some of the captains of industry and labor leaders was a proposal to form a local reconstruction committee, composed of the following:

The local members of parliament and the legislature.

The mayor, a member of the board of control and an alderman.

Three representatives of the trades and labor council, representing organized labor.

Three members of the Independent Labor party, representing unorganized labor.

Three manufacturers who are not members of the association, to be named by the board of trade.

A representative from the Ministerial Association.

Examination of Imported Goods

The Senior British Trade Commissioner in Canada and Newfoundland (Mr. G. T. Milne, 367 Beaver Hall Square, Montreal) has been notified by the Imperial Department of Overseas Trade in London that he is empowered to appoint an expert to examine and report upon consignments of goods from the United Kingdom, in respect of which a dispute has arisen, and to certify the signature of such experts as authentic. The Commissioner will, however, only intervene when requested to do so by both parties to the dispute. The kind of disputes in which the Commissioner may intervene are those regarding goods which are alleged to be not up to sample, or which have arrived in a damaged condition owing to faulty packing.

The British Trade Commissioner at Toronto (Mr. F. W. Field, 257 Confederation Life Bldg., Toronto) is empowered to act in disputes arising out of shipments to Toronto and to other centres in Ontario.

No Provision Made for Depreciation of Toronto Waterworks

The revenue and expenditure in connection with the civic water works plant in Toronto for the year 1918 was as follows:

Expenditure

Debt charges.. . . .	\$ 900,371
Revenue office maintenance.. . . .	69,399
Waterworks maintenance	906,565

Total \$1,876,335

Revenue

From the city itself	\$ 726,734
From metered customers	761,456
From tariff customers	917,570

Total \$2,405,760

From these figures it is seen that there is an apparent surplus of \$529,425, but, as pointed out by Finance Commissioner Bradshaw, there is no provision being made for depreciation, and whatever capital is required for renewals and extensions has had to be borrowed. The result is that the waterworks debt has already reached nearly \$16,000,000, and is continuing to increase.

It will be observed that over 30 per cent. of the revenue for 1918 was from metered services, though only about 4,000 out of the 100,000 services are metered. This is explained by the fact that it is the larger concerns and houses which are metered, and also that the meter customer is paying more for his water.

Mainly Constructional

East and West—From Coast to Coast

A resolution in favor of a 40-hour week and a minimum wage of \$5 per day, was passed at a recent meeting of trades unionists in the Labor Temple, Toronto.

At a recent meeting of the council of the municipality of Surrey, B.C., a deputation urged the "Good Roads" claims of White Rock and Crescent, with particular reference to the marine drive which is to connect these two points.

Brig.-Gen. J. A. Gunn suggests a system of memorial bridges constructed as needed throughout the country as a very useful and appropriate way of honoring the memory of the men from rural communities who fell in battle.

The Toronto Specialty Manufacturing Co., Limited, head office Toronto, capital \$40,000. Authorized to carry on business as iron foundries, mechanical engineers, manufacturers of agricultural implements and other machinery, tool makers, brass foundries, etc.

A delegation recently waited on Premier Norris of Manitoba to urge the advisability of having the Oakland branch of the C.N.R. from Amaranth to Winnipegosis completed. The Premier promised to do all in his power to hasten the work and the petition has been forwarded to Ottawa.

Farrelly Brothers, Limited, a company incorporated under the laws of the Province of Manitoba, has been licensed to operate as general contractors and manufacturers in the Province of Ontario with a capital of \$20,000. Thomas P. Farrelly, of Fort William, will be the firm's attorney for this province.

The C. N. Ry. programme in British Columbia this

year includes the construction of a freight and passenger depot in New Westminster and the extension of their line through that city to serve industries on the North Arm, according to assurances given a deputation which recently visited Ottawa.

Queen's University, Kingston, Ont., intends establishing a course in road-making in connection with its Practical Science Department, and Prof. Thos. S. Scott, who has been in Halifax for the past year in connection with reconstruction work there, is to return and take charge of the new course.

At a meeting of the Port Colborne, Ont., board of trade recently, a resolution was passed favoring the proposed erection of a bridge to be known as the International Memorial Bridge, the cost of which would be approximately ten million dollars, to be borne in proper proportions by the United States and Canada.

Mr. Frank Barber, consulting engineer, of Toronto, recently gave an address before the Engineers' Club of Peterboro on the subject of "Concrete Bridges," illustrated with slides of some of the finest bridges of this type in Canada, which he compared to the structure he is designing to span the River Otonabee at Hunter Street, Peterboro.

The board of trade of Pembroke, Ont., is reviving the scheme for a bridge over the Ottawa River at that point. The idea now being advanced, which is based on plans made by J. L. Morris, C.E., is a dam at the head of the Lost Chennail and the Allumette, with a bridge over the piers. It is claimed that adoption of the scheme would greatly benefit navigation in the Ottawa river above Pembroke.

The Navy League of Canada, at its annual convention in Victoria, B.C., recently, decided to grant the sum of \$200,000 for the erection of a Navy League home in Montreal, provided that the Protestant and Catholic homes, now existent, combine and sell their properties. The amount realized from the sale to be added to the \$200,000 granted and the total used for the erection and establishment of the new home.

Arrangements are being made by the various labor committees in Toronto for a parade of the unemployed to Queen's Park on Wednesday, March 5, when they will ask the Legislature to give them work. There will be deputations from the Metal Trades, Building Trades, District Labor Council, Machinists District Council, Carpenters' Union, the Plumbers' Union and other branches of the Trades and Labor Council.

A project has been introduced in the British Columbia Legislature for the expenditure of two millions in developing 600 soldier homes in Burnaby and South Vancouver. It is proposed to utilize a tract between Ardley, on the Burnaby Lake line, and McKay, on the Central Park line, about a mile from each station. In South Vancouver, it is the object that the Government take over 70 acres for the same purpose.

The need for the erection of a new 500-bed civic hospital in Ottawa, at a cost of some \$1,500,000, has been brought to the attention of the city council by a deputation representing all the important public bodies and organizations of the city. St. Luke's and the County of Carleton General Hospitals have signified their willingness to transfer all their various properties and assets to the city if this project is carried out.

A representative of the Port Arthur, Ont., board of trade, who recently visited Toronto to interview the Hydro-electric Power Commission, received assurance that head work for the full development of 50,000 h.p. on the Nipigon River would be completed by 1920. Orders have been confirmed

to proceed, poles have been bought, camps are erected, the railway has been built, and, by the spring, a large force of men will be employed on this work.

Another suggestion has been advanced in regard to the establishment of a permanent war memorial in the city of Winnipeg in the form of a street or highway. This new suggestion, made by Lieut. Leo. Warde, proposes a trans-city highway connecting up Edinburgh, Osborne, Colony, Balmoral, Isabel and Salter streets. A series of open squares or plazas would also be provided for in the project, to commemorate some of Canada's more notable victories in arms.

The City Council of London, Ont., has announced its intention to apply to the provincial Legislature at the present session for power to raise \$200,000 by debentures for the erection of a municipal building at the corner of Dundas and Wellington streets. There is, however, considerable opposition to this scheme, as it is considered that such a building would not be in keeping with the dignity of the city, and a more ambitious project, known as the Federal Square Scheme, which contemplates an expenditure running into, probably, a million dollars, has the enthusiastic support of many.

At a recent meeting the Chamber of Commerce of Kamloops, B.C., decided to petition the Dominion and Provincial Governments regarding certain construction undertakings. They urge that the Provincial Government now proceed to complete the Provincial home, according to plan, with fire-proof buildings. The Dominion Government will be asked to at once construct a drill hall, for which money has already been voted, and for which the city has purchased a site, and also to erect a post office and departmental office building. The Chamber is also anxious to have dredging and waterfront improvements carried out, and larger appropriations for the roads of the district.

That the best interests of the Province of Manitoba would be served by the provincial government assuming the construction and maintenance of the main trunk highways of the province, was the declaration made before Ministers of the government by a deputation representing the Manitoba Good Roads Association, the Manitoba Motor League, Winnipeg Board of Trade, and a number of other bodies. Hon. Geo. A. Grierison, in reply, pointed out that the programme for this year would involve the expenditure of from \$1,000,000 to \$1,500,000, if labor and material could be procured, while to take over the construction and maintenance of all highways would involve an expenditure of from five to six millions. It was intimated that a bill was being prepared which would insure more uniformity and co-ordination between the department and the municipalities, and Mr. Grierison promised that the various organizations represented would have copies supplied them and an opportunity of discussing the bill before the law amendments committee.

Personals

Mr. R. S. Lea, of R. S. and W. S. Lea, consulting engineers, Montreal, has undergone an operation for appendicitis.

Mr. H. Boyd, superintendent of the Vancouver Division of the C. P. R., has been promoted to the position of assistant mechanical engineer for the entire C.P.R. system, with headquarters at the Angus shops in Montreal.

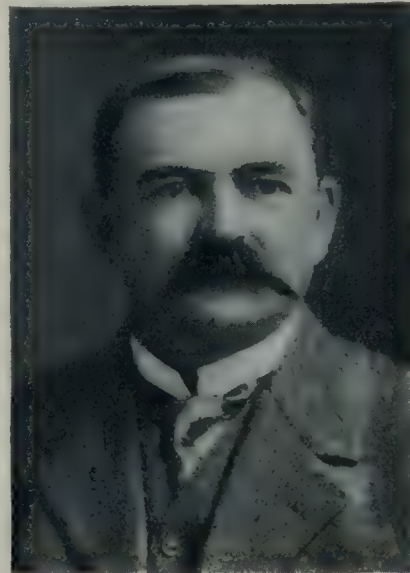
Mr. A. E. Doucet, director of public works for the city of Montreal, has received a letter from King George and Queen Mary, expressing sympathy on the loss of his son, Lieut. A. C. Doucet, recently accidentally killed while overseas.

Prof. Wright, Mr. Frank Wickson and Dr. John Noble, chairman of the property committee, have been chosen by

the Toronto Board of Education as judges of the competitive plans submitted for the proposed schools on Glen Grove and Glenholme avenues. The architects' competition is to close on March 31, and the judging will be held on April 1.

Mr. E. A. Cleveland, of Vancouver, the civil engineer who was recently appointed by the British Columbia Government to report upon the development of 22,000 acres of land just purchased in the South Okanagan district, has now been appointed comptroller of water rights for the province, succeeding Mr. Wm. Young, who has resigned.

Mr. J. L. Weller, the former chief engineer of the Welland Ship Canal work, who tendered his resignation when that work was closed down about a year ago, is now acting in the capacity of Consulting Engineer to the Department



Mr. J. L. Weller

of Railways and Canals. Some weeks ago, when it was decided to re-open the Welland Canal work, the Department offered Mr. Weller this position. His services, however, will not be limited to this particular undertaking, but will be available for all works.

Mr. F. W. Pratt has been appointed engineer for the municipality of Surrey, B.C. For the past two years Mr. Pratt has been connected with the engineering department of the Great Northern Ry., and previously for seven years held the position of assistant city engineer of Vancouver. He also has had engineering experience in the city of London, Ont.

Lieut.-Col. W. G. MacKendrick, D.S.O., who has won high military distinction for himself as Director of Roads with the Fifth British Army, has recently returned to his home in Toronto after more than three years of war service. Col. MacKendrick was in Canada on furlough early in 1918, but later returned to the front again and spent some days in Germany last January. In civil life, Col. MacKendrick is well known to Canadian construction men as president of the Warren Bituminous Paving Co.

Obituary

Mr. William E. Gray, builder and contractor, of Brockville, died on Feb. 21, after a brief illness, aged 57 years. He was an ex-member of the Board of Public Utilities.

Staff-Sergt. James L. Wallace, who, up to the time of his enlistment about four years ago, followed the building and contracting business in Toronto, has died of pneumonia on the eve of his return to Canada.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Amherstburg, Ont.

Town Council plans paving Murray St. Clerk, A. J. Burns.

Bornholm, Ont.

Plans and specifications are with the clerk, Louis George Rock, R. R. No. 1, Bornholm, who is receiving tenders until 1 p.m., March 18th, for construction of Ritz drain for Township Council.

Brantford, Ont.

Estimates have been submitted to City Council for storm and sanitary sewers costing \$50,000. Clerk, H. F. Leonard.

Hull, P.Q.

Quebec Provincial Government and Hull City will build highways from Hull to Rouses Point. Provincial Engineer, J. Levesque, Quebec. Work to start this summer.

Leamington, Ont.

Town Council plans paving Talbot and Marlborough Sts. Clerk, R. M. Selkirk.

Norwich, Ont.

Township Council plans construction of tile drain. Clerk, C. E. Burgess.

Orillia, Ont.

Tenders are being received by Town Council until March 22nd, for construction of various pavements throughout the town. The minimum tender is for 15,000 sq. ft. Clerk, C. E. Gratn.

Oshawa, Ont.

City Council plans improvements to several streets. Clerk, Thos. Morris.

Revelstoke, B.C.

Town Council plans construction of sixteen mile roadway between Boulder & Taft. Clerk, W. A. Gordon.

Swift Current, Sask.

Town Council plans drainage work. Clerk, George D. Arnott.

Timmins, Ont.

Waterworks system to cost \$116,000, contemplated by the Town Council, clerk H. E. Montgomery. Engineers, Sutcliffe & Neelands, New Liskeard.

CONTRACTS AWARDED

Pembroke, Ont.

Town Council has awarded \$9,000 contract for waterworks to Edward Behan. Owner is in the market for quantity of steel sheet piling.

Hamilton, Ont.

City Council has awarded the \$8,000 contract for sewers to J. S. Armstrong, 138 Erie Ave.

Railroads, Bridges and Wharves

Boston Creek, Ont.

T. & N. O. Rly., Toronto, plans construction of railway from here to centre of mining district. Chairman, J. L. Englehart, Toronto.

Cape Bald, N.B.

Tenders are being received by R. C. Desrochers, secretary Department of Public Works, Ottawa, until noon March 18th, for repairs to breakwater pier.

Fitzroy Township, Ont.

Patterson & Byrne, engineers, 71½ Sparks St., Ottawa, are receiving tenders for bridge abutments and piers for bridge over Mississippi River, for County of Carleton, until March 11.

Halifax, N.S.

Canadian National Rys., Ottawa, propose erection of bridge at Campbell Rd. Bridge Master, H. A. McElhinney, Truro, N.S. Structural Steel construction.

New Westminster, B.C.

C. N. Rly., Toronto, plans erection of freight and passenger depot. Gen. Manager, W. MacLeod.

Paisley, Ont.

Tenders are being received by Engineer, Fred. B. James, Walkerton, until March 10th, for rebuilding a bridge for County Council.

South Vancouver, B.C.

Plans are in progress for branch line to north arm of Fraser River for C. N. Rly., Toronto. President, D. B. Hanna, Toronto.

Timmins, Ont.

Town Council and T. & N. O. Ry. contemplate \$40,000 steel bridge at 5th Ave. Clerk, H. E. Montgomery.

Victoriaville, Que.

G. T. Rly., Montreal, plans erection of repair shops. Gen. supt., W. R. Davidson, Montreal.

CONTRACTS AWARDED

Carleton County, N.B.

Department of Public Works, Fredericton, has awarded the contract for construction of \$26,000 bridge to Concrete Builders, Ltd., South Devon, Fredericton.

Sackville, N.B.

Department of Public Works, Fredericton, has awarded the contract for construction of \$7,000 bridge to Messrs. Alexander & Roy Forbes, South Devon.

Public Buildings, Churches and Schools

Antigonish, N.S.

Plans are being prepared for four-storey building for the Sisters of St. Martha.

Blytheswood, Ont.

Presbyterian Congregation plans remodelling church. Pastor, Rev. A. W. Campbell.

Calgary, Alta.

Plans are ready for customs house for Department of Public Works, Ottawa. Architect, R. C. Wright, Robinson Bldg., Ottawa.

Chicoutimi, Que.

Plans are being prepared for \$175,000,

two storey church and \$25,000, three storey sacristy for R. C. Congregation. Architects, Oscar Beaulé & Alfred Lamontagne, 21 D'Aiguillon St., Quebec. Five hundred benches and new organ will be required.

Cloverdale, B.C.

Department of Public Works, Ottawa, has secured site for erection of convalescent home. Secretary, R. C. Desrochers, Ottawa.

Drummondville, Que.

Town Council plans erection of town hall and court house. Sec.-treas., W. A. Moisan.

Guelph, Ont.

S. B. Coon & Son, Excelsior Life Bldg., Toronto, is preparing plans for \$50,000 school for Board of Education.

Halifax, N.S.

R. S. Episcopal Corporation, Dresden, Row, contemplates convent on Russell St. Secretary-Treasurer, D. T. Lynagh, South Park St.

St. Joseph's Society, Gottingen St., contemplates erection of new hall to cost about \$35,000.

Darling & Pearson, 2 Leader Lane, Toronto, have been appointed architects for Girls' Residence for Dalhousie University, Cobourg Rd.

A. R. Cobb, Tramway Bldg., has been appointed architect for "Richmond" school by the School Board, 81 Sackville St. Board will shortly call tenders. Sec.-Treasurer, S. J. Wilson. Cost \$85,000.

Hamilton, Ont.

The Department of Public Works, secretary R. C. Desrochers, Ottawa, has plans nearly ready for a federal building in Hamilton.

Ingersoll, Ont.

By-law will be submitted shortly for erection of \$25,000 public school for Town Council. Clerk, W. R. Smith.

Kamsack, Sask.

School Board has purchased site for erection of addition to school. Chairman, E. C. Lawrence.

Kingston, Ont.

Tenders are being received by R. C. Desrochers, secretary of Department of Public Works, until noon, March 19th, for erection of educational block at Military Camp.

Tenders are being received by R. C. Desrochers, secretary of Department of Public Works, Ottawa, until noon, March 33th, for alterations and addition to stone building for military hospital. Pavilion "A".

Educational block R.M.C. planned by Dept. of Public Works, secretary R. C. Desrochers, Ottawa, includes assembly hall, 2 storeys and basement, and school bldg. 3 storeys and basement, structural

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Organization of Ontario's Building Industries

SINCE the annual meeting of the Provincial Builders' and Supply Association of Ontario, recently held in Chatham, the executive of the association has been hard at work developing a widespread organization campaign that will take in the whole province.

A strong provincial organization is made possible only through the strength of the local or district exchanges and an effort is being made to arouse the interest of all connected with the industry in districts that at present have no builders' exchange or other similar association.

The newly organized Association of Canadian Building & Construction Industries should be the parent association, but no national association alone can satisfactorily handle the many small problems of the individual exchanges in the different provinces.

The organization of the individual exchange should be the first effort in the general organization of the

Dominion. The parent organization of the individual exchanges is, logically, a provincial association. The varying conditions and laws of the different provinces make this absolutely essential. The Dominion Association would unite the various provinces and this arrangement would establish a chain of responsibility that would be effective and flexible. It would unite the exchanges in each province and in this way enable them to discuss and settle their purely local or provincial problems without reference to the Dominion association, while questions of a national character could be taken up by the provincial representatives to the National Council of the Dominion Association. Questions requiring provincial legislation could be handled to much better advantage by a provincial organization. Smaller problems are much more numerous than large ones and for this reason it would often be a hardship to have to wait for the national council to decide some question of purely local interest which could be settled much more intelligently and satisfactorily at a monthly meeting of the provincial association.

The question of representation at the meetings of the Dominion Association is another serious difficulty owing to the cost of sending a representative from each exchange in some instances right across the continent to attend a meeting. A representative from each section of the provincial association would represent the various exchanges of the whole province and in this way insure representation for all and at the same time eliminate a great deal of unnecessary expense.

The construction industry must confront the new problems that lie before it and it must rest with a united industry to handle the situation promptly and wisely. Concerted effort is so vastly superior to individual effort that the advisability of capitalizing the experience of the ablest men in the industry will readily be admitted by all.

Similar action on the part of the other provinces along the line adopted by Ontario would, we feel, be a most effective procedure and one most certain to result in the firm establishment of the Association of Canadian Building and Construction Industries.

Are Cheap Roads Profitable?

BUILDERS of roads should take into account the mental attitude and inherent rights of the average citizen whose money is spent in the construction of roads. The average man has no technical knowledge of road building and he judges a road solely by what he sees. He knows that there are several types of pavement, but he allows for no variations in type. A type of road is either good or bad in his opinion and no allowance is made for ignorant construction work, bad designs, or badly prepared specifications.

More flexibility in designing and less generalizing in road building would eliminate many preventable causes of failure. There are many causes for road failure that are easily determined when it is too late. Inadequate drainage, bad sub-grade, uneven foundations, negligence in rolling or the omission of the innumerable details necessary to the construction of a good road are often responsible for failure that is readily recognized by the engineer, but the average man, knowing nothing about such matters, condemns the type of roadway as a failure.

Cheap roadways may please taxpayers temporarily

ily, but when the road fails, as is to be expected, the taxpayer, in his mind, condemns forever that type of pavement.

Highway engineers should endeavor to make good on pavement construction in order to avoid the necessity of making excuses for failure.

The situation seems to demand education on both sides—education of road builders to the best methods of construction and the selection of the type of roadway that will be most efficient under the conditions of climate and traffic to which it is subjected, and education of the public to appreciate the fact that much of the money spent on a road cannot show immediate results on the surface and that no road can stand up indefinitely under heavy cars driven at high speed. It seems that just here are evidenced the advantages of the Annual Conference of County Road Superintendents, which was initiated by the Ontario Highway Department, and the Ontario Good Roads' Association's activities. The Conference is undoubtedly the best method by which the collective experience of the road superintendents of the province can be made available for the use of all to the general advantage of the public, by the resulting higher standard of road construction throughout Ontario. The Good Roads' Association on its part is helping to educate the public to the necessity of better highways, and, by its propaganda, bringing them to realize that these cannot be obtained without the expenditure of considerable money in a systematic manner and through a proper organization.

Daylight Saving

THE Daylight Saving Bill has been the subject of considerable discussion from time to time, and periodically the controversy becomes quite heated. Most decided views have been expressed both for and against the bill each side apparently being unable to convince the other of the soundness of their arguments.

In the United States the Daylight Saving Act will remain in force for another year. It cannot be repealed at this session of congress on account of the lateness of starting any movement to have it stricken from the statute books.

An exceedingly strong argument in favor of the bill is the prediction of labor leaders that a national daylight saving law, making all working hours daylight hours, would reduce the number of industrial accidents; in fact, this is said to have been borne out last year. In one state the number of industrial accidents last year under the operation of the daylight saving law was 93,036 less than the preceding year. It is argued that this accident prevention is due to the elimination of the late afternoon hours when physical energy is at its lowest ebb. This time is now given over to recreation.

Plans to Stimulate Technical Education

THE Government's policy for the extension of technical education in Canada will be of such great benefit and so far reaching in its effect that every effort should be made to foster the idea of making our technical schools meet more directly the needs of the various trades and industries of the country.

The industrial plants throughout Canada should be subjected to a thorough study in an effort to decide

the general industrial and technical educational requirements of those engaged in these plants. This, we understand, is being arranged for by the Department of Education, which has recently appointed two men for this work. In this way only can constructive recommendations be made regarding the best method of improving the organization of technical education to provide the industries or trades with a better trained type of industrial worker.

A survey of the more important industrial establishments will have to be made in order to establish the nature and character of training required.

This work of reorganization will be limited in its effect unless the government secures the co-operation of those most closely connected with the trades and industries. In this way only can the shortcomings of the present system be brought to light and a solution worked out that will be satisfactory to all interested.

Technical Bureaus Opened

THE bureaus for returned technical men, about which we have spoken in recent issues as receiving the attention of the Dominion Government, have now opened in Ottawa, Montreal and Toronto. The Toronto office is at 287 Queen St. West, and is in charge of Major R. D. Galbraith, late of the Canadian Machine Gun Corps and Canadian Railway Troops. These offices will have on file the names, qualifications, experience, etc., of returned technical men, this information being obtained during the home voyage. Letters are now being sent out to employers of technical labor asking their co-operation in getting these men into touch with suitable positions. The letter requests that all such employers immediately send in a detailed outline of the requirements of any vacancy or prospective vacancy in their organization. The location of other technical bureaus will be announced later.

Montreal Works Dept. Plans

MR. DOUCET, the chief engineer of the City of Montreal, has submitted a programme of public works, which has been approved by the Administrative Commissioners. This includes a suction conduit, which will give an additional supply of 20,000,000 gallons of water per day. The conduit is to be reinforced concrete, about 300 feet long, tenders for which have already been called. Messrs. R. S. & W. S. Lea are reporting on the question of utilizing the aqueduct in connection with the water supply, and the chief engineer suggests that the report should be referred to small committee of well known engineers and business men, to discuss, approve in its entirety, or make suggestions as to alterations which might lead to further betterments.

Mr. Doucet says that advantage should be taken of the work already done in the way of revision of the building by-laws by Mr. Francis and Mr. Venne. In order to bring this work to a practical end, a committee presided over by one of the commissioners and consisting of the consulting engineer, director and deputy director of public works, heads of the building and fire departments, and assisted by representatives from the Society of Architects and Builders Exchange should be formed. The work should be followed up conscientiously and actively as otherwise discussions will drag on without anything practical being arrived at.

County Road Superintendents and Engineers of Ontario Exchange Views on Practical Highway Problems

THE Fifth Annual Conference on Road Construction for County Road Superintendents and Engineers, under the auspices of the Ontario Department of Highways, opened in Toronto on March 3, with a very full attendance from all over the province. This conference extended over three days, overlapping with Ontario Good Roads Association Convention on the last day, when a combined meeting was held in the York County Buildings. Its object, as pointed out by Mr. W. A. McLean, Deputy Minister of Highways, who occupied the chair during the greater part of the proceedings, is to give the superintendents an opportunity of discussing the numerous phases of the work in which they are en-

In our last issue, two of the papers presented at the Conference were published—"Road Foundations, Drainage and Culverts," by Mr. Geo. Hogarth, Engineer of Highways, Ontario Department of Public Highways; and "Permanent Road Surfaces," by Mr. R. C. Muir, Assistant Engineer of the Department. We are now continuing the report of the proceedings:

Following Mr. Hogarth's paper, which was reproduced in our issue of March 5th, Mr. McLean made a few remarks on the subject of drainage. It was a subject, he said, which had been emphasized again and again, yet when the Province took over one of the oldest highways in Ontario, the first thing they had to do was to drain it. If this was the case on a long-established and important highway, what were the conditions on local roads which were considered of less importance? The illustrations showed in a very clear way that the main point was to keep the water from getting under the roadway. The most effective way of doing this was by means of the old open ditch, particularly in clay soils. There were some soils of Ontario of a fairly porous nature where the drains were probably as effective as the open ditch, but there were classes of soil that could only be drained by means of an open ditch, or by means of an expensive under-drainage system top-filled with stone. In some part of the province, the problem was comparatively easy, but in others the country is flat and the soil heavy, and in such locations a simple tile drain will not be effective.

Mr. McLean announced, with regret, that Mr. J. M. Young, county road superintendent of Wellington, who was to have led the discussion on Mr. Hogarth's paper, was unable to be present owing to sickness. Mr. U. W. Christie, county engineer of Dufferin, was then called upon to open the subject. His remarks were as follows:

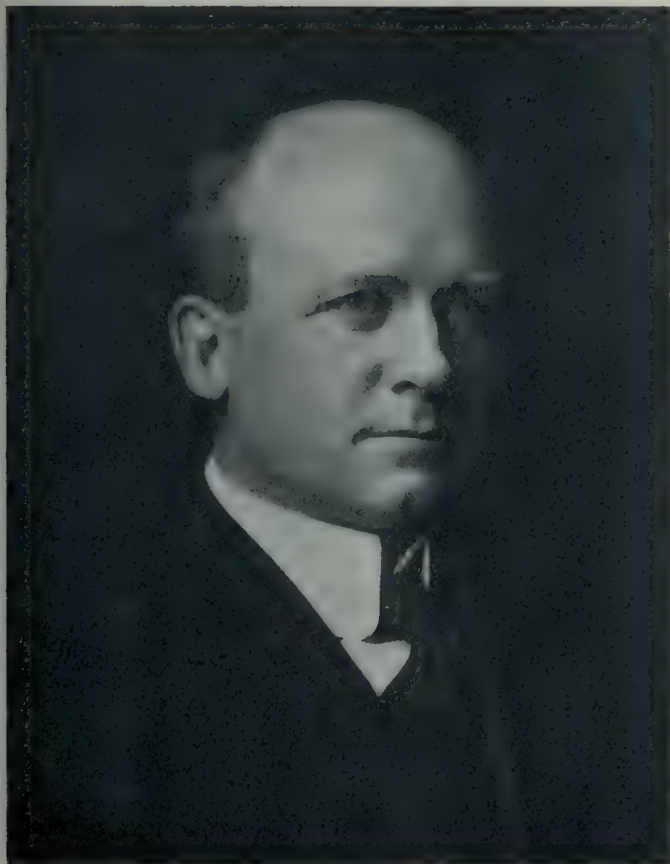
Road Foundations, Drainage and Culverts

By U. W. Christie

WHEN we consider some recent failures in what were previously considered good roads, the problem of the immediate future is going to be the development of adequate foundations to handle the heavier class of traffic.

Failures have largely been the result of weak foundations at the time frost is "coming out of the ground," when the water content of the soil is high and foundations are consequently weakened. What degree of weakening is permissible under any conditions before failure is reasonably certain, is not known because we never know, even approximately, the factor of safety in the bearing power of our subgrade.

Some studies by an engineer interested in public roads gives the following interesting data: Clay below



Mr. W. A. McLean, Deputy Minister of Highways, Ontario, whose Department is responsible for getting the county road superintendents together annually

gaged. The subjects on the programme were introduced by short addresses from engineers and superintendents and these were followed by informal discussions with a view to securing an interchange of ideas among those present. There were a large number of lantern slides shown, illustrating various phases of topics discussed, and also motion pictures showing actual road building operations in progress.

a concrete pavement contained 19 per cent. by weight, or about 46 per cent. by volume, of water. In another case clay contained 12.7 per cent. by weight. Clay loam under an asphalt pavement on a 7-inch concrete base contained 13.6 per cent. by weight, or about 33 per cent. by volume, of water. A sand cushion on a concrete base under wood blocks, may contain as high as 12.7 per cent. by weight of water.

The above figures are roughly the natural water content of the various materials under the given conditions.

The following table shows the height to which capillary water rises in certain soils in 24 hours:

Light sandy soil	14 inches
Gravelly soil	16 "
Decomposed granite (loam)	21 "
Heavy granite loam	16 "
Heavy clay loam	11 "
Heavy lava ash	16 "
Pure sand	9 "

In one day the capillary water moves upward about one-half its apparent final limit. In three days it moves about two-thirds its apparent final limit. In some soils the movement upwards in the first two hours is as high as one-third of its movement for 30 days. In pure sand it rises in one-half hour approximately one-half as high as in one day, and in one day about 70 per cent. as high as in twelve days. The movement is more rapid at the start in light soils, and slows down rapidly. After three days the movement is exceedingly slow in pure sand. In heavy soils the movement is uniformly slower and more sustained. In light soils the per cent. of water in the soil decreases rapidly with the height above the source of water, while in some heavy soils the water content is strikingly uniform at different depths.

Horizontal capillarity occurs with much faster water movement and greater uniformity of moisture content. The speed and distance vary with different soils and ranges from 7 to 33 feet in the first 24 hours.

Capillary Action

The rapidity with which capillarity occurs when there is a free source of water makes it necessary to remove this source with the greatest promptness if a substantial road foundation is to be maintained.

If it is absolutely necessary to allow water to stand or flow along a road embankment for even a few hours, the height of the sub-grade above the surface of the water and its distance horizontally from the water source must be considered.

Should we have a wetted side drain for only one day at a time a height of sub-grade of 18 inches will, in all probability, be sufficient, and should the horizontal distance to the drain be large the 18 inches may be reduced, but if the wetted side drain is to remain for a considerable time the height might have to be increased as much as 2 or 3 times the above figure.

The road builder should not only strive to get the water out of the road foundation into the side ditches as quickly as possible, but he should also strive to get the water out of the side ditches and off the road as quickly as possible.

Culverts should be built at low points and ditches should be constructed with a uniform grade to and from them, both culverts and ditches should be kept free of all obstructions that will impede the free flow of water. A special effort should be made each fall

to remove all trash and debris collected at entrances and outlets of culverts.

Sub Grade

A dry sub-grade is a good foundation for almost any of the ordinary bases if it be properly shaped and rolled prior to surfacing. Thus a ridge road is always a good road with a side hill road, if proper outlets are opened, a close second, the secret being that they are easily drained and, consequently, are generally either naturally or artificially sufficiently drained. On the other hand a swamp road is invariably a bad road, as nature has not provided for a dry sub-grade and artificial drainage is difficult and expensive and in the past has been greatly neglected. In many cases a canal or canals have been dug along the side or sides of the road, and these though they have no proper outlets, are used as dumping grounds for the neighboring farms. Before road construction is attempted such drains must be carried to outlets and if the water cannot be lowered sufficiently a foundation not seriously affected by capillarity must be built. Such a foundation might consist of a layer or two of field stone, 8 to 12 inches thick, covered with crushed stone or coarse screened gravel. Probably a telford foundation would be better, but hand placing of stones is a tedious and expensive job and, at the present prices of labor, is, except in extreme cases, not warranted. If the conditions be somewhat more favorable and the traffic not too heavy, a layer of from 4 to 6 inches of coarse crushed stone might be sufficient. In any case tile sub-drains must be placed at intervals, depending upon conditions, leading to the side ditches, and if these sub-drains are not too expensive they cannot be too frequent. On side hills which are wet one tile drain 4 or 6 inches in diameter, placed on the high side at a depth of 3 or 3½ feet and bedded in gravel will usually be sufficient, but on wet cuts, two side drains will be required.

Vehicle Load on Roads

If we consider the maximum load allowed on county roads, that is a vehicle weighing 12 tons with a maximum pressure of 650 pounds per inch of tire width and that two-thirds of the load or 8 tons are carried on the rear axle, we have a weight of 4 tons per rear wheel which would require a tire width of over 12 inches. Now if we assume that the pressure is carried downward at an angle of 30° with the vertical, and that a gravel subsoil will support 8 tons per square foot, firm clay, 4 tons per square foot, damp clay, 2 tons per square foot, wet clay, one ton per square foot, and wet yielding soil only one-half ton per square foot, we would require a depth of crushed stone of approximately 3½, 6, 9½, 16½, and 25 inches, respectively, in addition to the wearing surface.

In the last two cases a condition is met, which requires special consideration. If this heavy class of vehicular traffic were very limited it appears that the reasonable thing to do would be to prohibit its use on the road during wet seasons. On the other hand if this heavy vehicular traffic represented a fair proportion of traffic it would appear that the road should be made to accommodate it. Special draining should be resorted to or it might even be necessary to practically bridge the soft places by using a telford base.

The cross-section of the road should be continually changed to meet continually changing conditions of sub-grade.

Culverts are placed on the line of natural or arti-

ficial watercourses and generally at right angles to the centre line of highway as this saves in cost. It is not good practice to place all culverts at right angles to the centre of the road as there are conditions arising in which such an arrangement would not at all apply to the drainage requirements, and it is well to remember that the object of a drain is to facilitate drainage and a culvert being part of a drain, has like duties to perform.

It is not safe to depend upon any general simple rule to determine the size of a culvert as conditions are so different. The size depends upon the rate of rainfall, the extent of area drained, the rate of slope, the character of the soil, the shape of the area, the presence or absence of bush, and the season. A small area will require a proportionally larger culvert than a larger area, a circular or square drainage area will require a larger culvert than a long narrow area. A well defined valley requires a larger culvert than one consisting of a flat slope. In warm weather the size depends upon the porosity of the soil and the extent of evaporation. On sandy soils 30 to 50 per cent. only of the rainfall will reach the culvert and on heavy clays, 90 to 100 per cent. Long, heavy rains will saturate any soil until nearly the entire rainfall will run off. Frozen ground will give 100 per cent. run-off, to which should be added allowance for rain melting snow. If all the rain falling on an area reaches a culvert in 30 minutes and if the maximum rainfall recorded in 30 minutes is $\frac{3}{4}$ of an inch, the rate of rainfall to use in designing a culvert for that area, would be a rainfall of $1\frac{1}{2}$ inches per hour.

Small Culverts

Small culverts are usually pipe, either cement, vitrified clay, cast iron or corrugated metal, with an upper limiting size of about 30 inches diameter though much larger sizes may be procured. Be sure to lay all pipe with a grade dropping to the down-stream end and that the conditions at the lower end of the culvert will carry off water as fast as the culvert discharges. All pipes should have a covering of at least 1 foot, and where the traffic is heavy the covering should be at least 2 feet. If the fill is not less than two feet or more than 10 feet, double strength vitrified sewer pipe may be used; these are made in lengths of 2, $2\frac{1}{2}$, or 3 feet. If the soil is firm, for pipe up to 15 inches in diameter, excavate about one foot wider than the over all diameter of the pipe and about 8 inches below grade. Fill the extra excavation with well-packed gravel and bed the pipe thereon, being sure to secure a proper bearing throughout the entire length of pipe. Lay the pipe to the true line and grade, beginning at the down-stream end and facing the bell ends up stream. Caulk joints with oakum and fill in the remainder of the joint with a mixture of 1:1 sand and cement. In back filling place the material in thin horizontal layers and tamp well under and for some distance above the half height of pipe, but be careful not to tamp too much just above the pipe. For pipe 15 inches in diameter and over, excavate about 3 inches below the bottom of the pipe and about 6 inches wider than the outside diameter of pipe and place and joint as for smaller pipe, but fill the extra excavated space with concrete of the proportion of 1 cement, 3 sand, and 5 of screened gravel with no stones exceeding $1\frac{1}{2}$ inch in largest dimension or if suitable pit run gravel is available use in proportion of 1:6. The pipe must be bedded on the

concrete and the concrete well packed around the pipe and brought to the half height of pipe filling the entire excavation. Above the half height of pipe it slopes up to top of pipe where it has a minimum thickness of three inches above the pipe. For a 15-inch pipe this requires slightly over 5 yards of concrete to the 100 feet of culvert. Cast iron pipes, on account of their great weight and present cost, are not much used.

Pipe Culverts

Corrugated metal culverts are much used in highway construction, as corrugation gives a very high strength in proportion to the weight of material. They are made in sizes from 8 to 84 inches in diameter and in two styles, semi-circumference section and complete circumference section in lengths up to 40 feet. Longer lengths are obtained by fastening two lengths together by using corrugated metal collars supplied by the makers. All corrugated culverts should be galvanized.

All pipe culverts are better if provided with cement concrete end walls which should in general extend two feet below the invert of the pipe and reach to a height above the pipe sufficient to hold back a fill with a side slope or $1\frac{1}{2}:1$. Such a wall at the end of an 8 inch pipe would be 4 feet 2 inches long, and would contain .77 cubic yard, at the end of a 10 inch pipe would be 4 feet 10 inches long, and would contain .92 cu. yards, at the end of a 12 inch pipe would be 5 feet 6 inches long and would contain 1.08 cubic yards, and at the end of a 16 inch pipe would be 6 feet 10 inches long and would contain 1.42 cubic yards.

Concrete Culverts

Probably the best material for culverts over a 2 or 3 foot span is reinforced concrete. A combination of steel and concrete constitutes a form of construction possessing to a large degree the advantages of both materials without their disadvantages. Steel is a material specially well suited to resist tensile stresses, and for such purposes the most economical form—the solid compact bar—is well adapted. To resist compressive stresses steel must be made into more expensive forms, consisting of relatively thin parts widely spread, in order to provide the necessary lateral rigidity. A serious disadvantage in the use of steel in many localities is its lack of durability.

Concrete is characterized by low tensile strength, relatively high compressive strength, and great durability. It is also found that steel well covered by concrete is thoroughly protected from corrosion. Concrete is also a comparatively cheap material and is readily available in most localities.

* * *

Open Ditch a Menace

Mr. Chas. Talbot, county engineer of Middlesex, suggested that the reason why drainage had been neglected in so many cases was because a great deal of money might be expended upon it without any immediately apparent result. The public could not see where the money had been expended, and did not give credit for it. Moreover, it was the first essential, and failure was bound to result if it was overlooked. In regard to the open ditches, he said the municipalities were up against legislation; they had to pay for the accidents. Personally, he had come to the conclusion that the big open ditch was a serious menace, and that the time had come when people would de-

mand that human life rather than dollars and cents should be the first consideration in the building of a road.

Mr. Christie, county engineer of Dufferin, suggested that by putting the ditch on the outside of the fence, the danger of accidents might be eliminated.

Mr. Wm. Forbes, superintendent for Oxford County, said that one of the first things they did in improving a road was to install a tile drain. They did not favor large open drains.

Mr. L. A. Pardo, Kent County road superintendent, said that in his county they were trying to get away from the open drains along the roads and replace them with tile. He was anxious for information in regard to the length of life of corrugated pipe for culverts. Personally, he never had faith in pipe of any kind, but always favored a nice square concrete culvert.

Mr. F. G. Campbell, superintendent for Simcoe County, expressed the view that the open ditch was becoming more in favor, and that it was undoubtedly the most effective. He suggested putting a rail, if necessary, as a means of accident prevention.

Mr. John Roger, road superintendent of Perth, was strongly opposed to the open ditch. In the construction of such a ditch in the spring of the year, it defeated its own object, filling up with ice and backing water on the road. There was no land in their county not drained by tile.

Mr. T. R. Allison, Wentworth county superintendent, instanced a case in which a horse frightened at

a stone, dumped the buggy in an open ditch and cost the county \$200 damages.

Mr. G. R. Marston, county engineer of Norfolk, said that in his county they had ditches six feet deep. In the spring time these were needed to carry off the flow of water, and they could not possibly afford to replace them with tile. As regards running the ditch down the farm instead of along the road side, he said it was rather the practice for the farmer to dig his ditch to the road for an outlet. He considered it was the duty of the superintendents to take this matter up, under the Ditches and Watercourses Act, and keep the ditches on the farm.

Mr. McGeorge thought that the matter of open ditches was a question of good judgment. There were many cases where an open drain on the road was desirable, where it could be used without being excessively deep and graded to the side of the road. On the other hand, through deep cuts it becomes a serious menace. In some municipalities of Kent county, serious conditions had resulted from the fact that the roads were impassible as first laid out and the only way of relieving the situation was to dig deep drains. They had also gone to the extreme of putting in drains where they were not needed. His own practice was to keep off the road as much as possible. There was also the form of construction combining the moderately deep open drain with a tile drain at the bottom, which seemed to give good results. Pipes were not desirable according to his experience, as they were too easily obstructed.

Earthwork and Grading Operations, Methods and Equipment

By A. R. McVicar



Mr. A. R. McVicar

THERE has been assigned to me, the subject of earth work and grading, a subject which I find very difficult to describe the workings of in detail from the platform or on paper, but something I should consider very easy to demonstrate in actual operation.

I will, however, try to tell you the ways and means by which I do the different operations required in handling and moving earth. In this matter

of earth work, we have different classes of earth, varied locations, various conditions and many devices with which to do the work. As for the tools, implements, vehicles and machines needed, it is advisable to find the relative value of each, the purchase price, adaptability, capacity, limit of hauling-yardage moved by each per day and cost per yard of earth moved.

In case of steam shovels or industrial railway plants, we require also cost of installation, insurance, upkeep and depreciation.

Style of equipment to be purchased depends on the amount of work to be done or the prospects ahead. The adaptability on the classification, location and haul. Capacity is usually governed by the length of

haul. The yardage depends on the method of loading and the efficiency of the gang. The price per yard depends on the push and vim of the foreman. The installation of your equipment depends on the amount of material to be moved at that seat. The upkeep depends on the care and skill of the operator in charge. The depreciation on the housing and care in storing, as in many cases the depreciation is greater when idle than when in operation, under proper handling. As to adaptability, if we were to come across a cut containing one hundred and twenty-five thousand or one hundred and thirty thousand cubic yards of earth, having a face of from forty to fifty feet, this earth to be hauled from one to three miles, you would all agree with me that the outfit most adapted for this would be a sixty-five ton shovel, with a two and one-half yard dipper, capable of digging eighteen hundred to two thousand yards per day and with two trains of twelve yard air dumps. This sized cut would pay for the cost of cutting in the shovel, laying the track, etc. and still leave enough material to be moved to insure a fair profit on the whole outlay. In a cut of seven thousand of eight thousand yards, you can see that the Industrial Railway, with one and one-half yard dumps and dinky engines or horses would prove the most satisfactory investment. We thus, can understand that quantity is a factor which governs the adaptability of the installed equipment.

Let us make a little review of the lesser devices.

such as hand shovels, barrows, carts and slush scrapers. The hand shovel is so small that it seems of little importance, but there is considerable importance attached to the proper selection of shovels. If you want a man to do a good day's work, it is necessary to furnish him with a good tool. A short handled, round mouthed No. 2 is my choice for almost any class of work. The pointed scoop is best for a teamster to throw on a load of gravel or sand, but altogether too large for a day's constant shoveling. As far as the long handled shovel is concerned, I have yet to find a place for it on construction. The barrow has its place still, such as filling in the approaches of bridges or culverts and widening a bank or fill where teams cannot be used to advantage. Where the haul does not exceed seventy-five feet one man should load and wheel out fifteen yards per day, or six men, ninety yards. At a comparative rate of two dollars per day per man that would bring the cost per yard at thirteen and one-third cents. Doubling the length of wheel would increase the cost to about seventeen cents per yard. That is the limit of the barrow haul or wheel for the reason that they can be replaced by carts that will move the earth for less money. As it takes three carts in order to keep six shovelers at work, with two carts loaded and one empty, the six men should load into the carts one hundred and twenty yards per day, or twenty yards each. Figuring the three horses at two dollars each and two dollars for a driver, this would amount to twenty dollars in all; that would mean sixteen and three-quarter cents per yard. The limit haul of this outfit of three carts would be two hundred and twenty-five feet. As the haul gets longer it requires one extra cart to each additional two hundred and twenty-five feet. A haul of fifteen hundred feet would bring the cost per yard up to forty cents, making an average of twenty-eight cents per cubic yard on a haul varying from two hundred and twenty-five feet to fifteen hundred feet. Replacing the carts with dump wagons would amount to about the same thing, or possibly a gain of one or two cents per yard. There is another method by which to load these vehicles, that is by trapping with slush-scrapers or small wheel-scrapers. You would find that the cost of loading would exceed that of the hand shovel, but on account of being a more rapid method of loading it would lessen the cost of hauling. It is not advisable to use the trap except when labor is not obtainable.

The Slush Scraper

Now we will see what can be done with the slush scraper. In order to do good work with the scraper it is necessary to have the ground properly plowed and, therefore, we must select the proper plow. As for the long handled farm plow, I have the same opinion of that as I have of the long handled shovel, not on account of the handles alone, but on account of the shape of the mould board. You will notice especially in stiff clay or gumbo that this plow simply turns the furrow over, leaving it almost, if not entirely, intact, making it almost impossible to load into a scraper. The railroad plow, on account of the abrupt out-turn of the mould board, leaves the furrow broken into short chunks, a proper condition for loading. All classes of earth, no matter how loose or soft, require to be plowed, for the reason that you will find a certain suction in unplowed earth that does not exist in plowed earth. It is necessary to plow narrow at all times, and for shovels or slush scrapers, as deeply as

possible. It is not necessary nor advisable to plow so deep for wheelers. I would like to make this claim for the slush scraper, that there can be more earth moved in the same time for less money with the slush scraper than with any other device known. That is to use it where and how it is intended to be used, viz., making a side fill, a side cut and fill, or wasting a cut to a depth of not more than six feet. It takes five scraper holders and one four-horse plow team and ten slusher teams to make a complete gang, the ten scrapers to be divided into five swings, with one holder and two teams to each swing, with one swing to every one hundred feet of road. By keeping the teams going in a circle they will move one thousand and eighty yards per day, or an average of ninety yards per team, plow teams included. At a comparative rate of six dollars per team the cost per team and scraper holder would be about seven dollars per day, that would be moving this earth for seven and two-thirds cents per yard. Taking an end haul of one hundred foot distance, including the turn at either end would bring the round trip up to two hundred and fifty feet. Travelling at the rate of two and one-half miles an hour, eight scraper loads per cubic yard, would be moving thirty yards per team, costing twenty-one and one-third cents per yard. Two No. 3 wheelers, one snatch team, one four-horse plow team, two wheeler-holders and one dump man on this same haul at a total cost of thirty-six dollars per day will move three hundred yards or an average per team if sixty yards, bringing the cost, per cubic yard, moved at twelve cents. Increasing this haul to two hundred feet with the slushers would bring the cost per yard to about twenty-one cents, an extra cost of nine and two-third cents, while the cost with the wheelers would increase to fourteen and one-half cents per yard or an extra cost of about two and one-half cents. By these figures you will see that the limit of the slusher haul is where you leave the circle. The limit of the wheeler haul is about six hundred feet. But in the event of replacing the wheelers with dump cars the limit should be considered four hundred feet, being the distance where the cost of wheelers equals or exceeds that of the cars.

Time will not permit me to go into the cost of operating cars, but having been associated with and worked the dump cars off and on for over thirty years, I make this claim, that this is the most efficient means by which earth can be handled at a distance of over six hundred and up to thirty-five hundred feet. The Fresno is another means which works very satisfactorily in taking down steep embankments, etc. They can be easily loaded and dumped by the drivers.

Road Grader or Scraper

I shall now endeavor to describe the method of grading with the road grader or road scraper. I have tried out this machine drawn by two teams of horses that proved very satisfactory. Then I tried three teams. This was more of a success, but altogether too expensive. I then secured two 8-16 h.p. kerosene tractors, which proved to be a little on the light side. I then got a 10-20, which seems to be alright. I have been told that the 10-20 is also too light, but that is a matter of opinion, as I believe that the tractor is heavy enough for the grader and that the grader, (which is a Sawyer-Massey No. 2 steel grader), is heavy enough for the work I have to do. The earth can be taken off the road bed or onto it in better

shape by going twice over it with this light outfit than by pulling up a conglomerate mass of lumps and stones with one turn of the heavier outfit.

We have in connection with this outfit a van in which the operators live. We usually leave this van about one mile from the end of the road and work both ways from it. In starting work where the ditches are formed, that is after a fashion, we have the sods removed from the outer edge of the ditch towards the fence, that is where the roadbed is not the required width. Next, I have the sod shoulders on the roadbed removed toward and then across the ditch on to the boulevard. This being done, if we find that the ditches are deep enough for proper drainage and the centre of the road bed high enough, we then continue to heel off more from the shoulders. This earth follows the sod to the boulevard. By doing this we are forming the crown of the road as well as lessening the apparent depth of the ditch, although in reality deepening it. Next the grader passes up and down the centre of the road with plenty of pressure on the blade to remove all the solid lumps. This is to have as smooth a surface as possible to receive the loose earth which is to come up from the ditch in the finishing process. Having this smooth surface to receive the loose earth is as necessary as it is to have a smooth and uniform surface on which to lay a permanent pavement. This road, when finished, has a width of twenty-four feet and a crown of twelve inches. I have two reasons for moving all the sod and rotted vegetation from the roadbed instead of putting them on it. The first reason is that I want to do away with ditches and replace them with gutters or water tables. By doing so you have a water course wider and less dangerous than the ditch. Where there is a considerable fall to a course there is less danger of a wash-out, as the water is not concentrated in a narrow space and has not the depth and, consequently, not the weight or force. The second reason is that it is necessary to get below and remove all the fertile soil from the road in order to get down to the subsoil which contains some consolidating qualities. It is true the surface soil will get very hard when it becomes dry, but will open out with large cracks. This is not the case with the subsoil. As for the sod, what is it composed of, especially that on the shoulders of an old travelled road? It is composed of decayed vegetation and horse manure, washed and splashed there after heavy rains. This material will never pack. After this stuff is moved and scuffled over a few times, it is surprising how little is left of it. But as a little bit of dust in your concrete gravel or a bad sack of cement will do immense harm to your wall or abutment, so this slight mixture of rotten vegetable matter will work a great deal of harm to your finished road surface.

The railway construction engineer's rule in this connection is worthy of note. A railroad company will not allow a permanent track to be laid on surface soil, but requires it to be moved before receiving the track ballast. This should appeal to us in the same manner.

The figures contained in this paper as to wages are based on the rates current before the war and not the rates now prevailing.

Of necessity a great deal of the information given above is elementary but I hope some of it will be beneficial to those who have not yet had experience along the lines of earth work.

The discussion on Mr. McVicar's paper was opened by Mr. S. McClure, county road superintendent of Carleton, whose remarks were as follows:

Proper Grading Essential for Permanent Highways

By S. McClure

EARTHWORK and grading are the fundamental principles, in my opinion, the main object of what we are all working for, looking for and hoping for. That is, that we may have better and more permanent highways. For I consider that the grading and draining are the main factors essential to the durability of roads.

For without the water being first removed from the road and the grade properly made, the chance of success is not very great, even though there may be a coating of stone or gravel placed on top.

I feel loathe, in my humble capacity as superintendent, to attempt to lay down any rules that will be of benefit to those gentlemen of great experience who are assembled here.

First, I will give you my opinion with regard to the work, in the hope that benefit may be derived from the discussion afterwards.

In starting the work, first go over the road to be constructed, observe closely all conditions, have the roadway cleared of all obstructions. Stake out your road in the centre of the road allowance, as the alignment of the finished road is of very great importance. Measure from the centre stakes to the side one-half the width of the road it is intended to build, if 24' measure 12', then place pickets in straight line and at reasonable distance apart, and with a good ploughman make one score of plough on each side of road. If the surface is uneven, heights to remove or depressions to fill, I advise doing this first with wheel scrapers or slush scrapers, as it gives a better chance to form your ditches and have the bottom on an even level. Then come on with your grader. I have generally used three teams on grader and one on plough. I find that more work can be accomplished by the grader following the plough, after the first two rounds are made the grader can handle the two plough scores to drift earth to the centre. Care should be used wherever there has been a depression filled to see that side or berm is carried up in accordance with the centre of grade. Whenever there are sods or lumps a disc harrow is very useful to thoroughly pulverize the same and give a smooth surface to the finished road. The crown to the newly graded road should not be less than one inch to the foot from side to centre of road. Care should be taken to have good crown on hills so as to prevent water coming down on roadbed. Dispose of water whenever possible instead of carrying great distances along highway as it is detrimental to the safe keeping of the road-bed.

Besides using horses for grading purposes we have had a trial of oil tractors and steam engines. An oil tractor 27-50 has been used very successfully. A 17-34 tractor we started recently was very satisfactory but owing to wet weather we had to discontinue the use of it. However, I think it will be very suitable for grading purposes. Still, in my opinion, to leave a nice finished job horses cannot be beaten.

Finishing your ditch you can work the grader on

the back of the ditch and trim the back to any angle, and either throw the earth back of the ditch or else bring it out on the road. When we have done this I consider it adds to the appearance, as well as usefulness of the drain.

* * *

Long Handled Plough Recommended

Mr. L. H. Pardo, county road superintendent of Kent, next took up the discussion. He said that his experience was all unfavorable to the use of the short-handled plough, which Mr. McVicar recommended. He could not get it to stay in the ground and could not get enough horizontal power. He agreed with Mr. McVicar that the proper practice was to plough as narrow and as deep as possible, but he considered that the long-handled plough was decidedly the better. As to road widths, he had noticed, coming down on the train, many roads which were narrow and good, and he had come to the conclusion that in his own county they were, perhaps, a little too wide. A road of 22 to 24 ft. width, leaving a shoulder, he found to be fairly satisfactory. The shoulder would keep many a car out

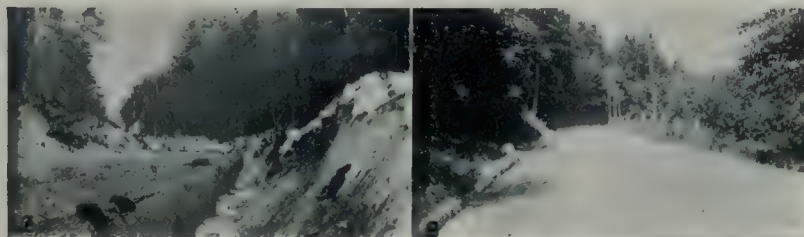
Mr. McClure emphasized the necessity of dumping scrapers at proper intervals in order to get a level roadbed.

Mr. McVicar said that in the use of the short-handled plough a great deal depended on the way in which the point was prepared. In a heavy, thick gumbo, give a dip of $\frac{3}{4}$ in., and also dip the shear.

Gasoline Tractors

In answer to a question with regard to the gasoline tractors, Mr. McClure said that in its use for grading work the most important thing was to have a good operator and a good grade man. He found the No. 10 grader very satisfactory. The cost of operation ran about \$15 a day, and he considered it the most economical method. The tractor could also be used for pulling out stones of almost any size. In regard to the ploughs, he favored the short-handled type. The tractor he used was a 2754, and with it a heavy grader was required. The cost of the tractor was \$4,500.

Mr. Peter Robertson, Lincoln county road superintendent, recommended a No. 8 grader with a 1734 tractor, using gasoline. This outfit had given him ex-



One of Ontario's Highways before and after improvement

of the ditch. Regarding the handling of earth, he thought it would be hard to beat the drag scraper; wagons and shovels were pretty slow. He had used the wheel scraper, also, with good satisfaction. Up to 600 ft. this latter type of scraper was pretty efficient.

He had found in connection with drainage that the grading and drainage work in very well together. One could often drain and grade a piece of road all at the same time. He was trying to get away from open ditches in his county, where at present conditions were not as safe as they should be.

Mr. McLean pointed out that as to the relative efficiency of implements, a great deal depended on how they were used.

Mr. Geo. Martindale, Victoria county road superintendent, expressed himself as unfavorable to the open ditch.

Special Type of Slip Scraper

Mr. Frank Pineo, superintendent for Elgin, had not found the short-handled plough very satisfactory, owing to the difficulty of holding it in the ground, and he also disparaged the wheel scraper. The men did not like it and it made the horses' necks sore. He had had a special type of slip scraper, 10 ft. long, made in the city, which he considered gave very good results. It was made very similar to the wheeler in shape, with wooden handles on it and a square front.

Mr. Milne said that in Essex county they combined grading with drainage in almost every case. He generally used the slush scraper, levelling off with it before the earth gets hardened.

cellent satisfaction and was of sufficient capacity for any work he had to undertake.

Motor Trucks

There was some discussion as to the use of trucks. Mr. C. R. Wheelock, county engineer of Peel, quoted figures given by Mr. Frank Rogers, State Highway Commissioner of Michigan, stating that the motor trucks made five trips with three yards of material, as against two trips with two yards by the teams.

Mr. Robertson referred to a Ford truck used by the Ontario Highway Department for maintenance work, which he considered was doing splendid work.

Mr. Parker, of the Department, said this truck was used for general haulage when stone was being shipped in. The truck was used for longer hauls and the teams for shorter. Stone for repair work was piled by teams and the truck driver used as a helper. The cost for gasoline and oil was between \$12 and \$15 a month. The use of the truck for patching work proved very satisfactory. Timing the operation of the truck, they had found that the driver and a helper going to the car for stone, taking on a load of about 1 or $1\frac{1}{4}$ tons and unloading in the pile, could be on the way back inside an hour on a three-mile haul.

Mr. McLean said he was convinced the truck was useful for repair work, but where it has to run on soft ground it was subject to a good many hold-ups. Where there was any serious amount of hauling for a distance of six to eight miles, a steam tractor with a wagon train was a good proposition as compared with teams.

Highway Organization A Topic of Much Discussion

On Tuesday, March 4, the meeting opened with a paper on "Ontario's Highway Organization," by Mr. C. R. Wheelock, county engineer of Peel.

Following the reading of his paper, Mr. Wheelock made some interesting suggestions. One was that uniform road signs be adopted throughout the province. The Department might make it compulsory to use the signs, and perhaps supply them. Another question he brought up was in regard to provincial county roads. On some of the roads thus designated there was heavier traffic than on parts of the provincial highways. These provincial-county roads would eventually cover the province and he thought that they should be most carefully selected, and when they had to carry an excessive amount of traffic, there should be some means of determining it and awarding an extra percentage of financial assistance by the government. He did not suggest that there should be increased grants to all such roads, but where the traffic exceeded a certain amount, say 100, 200 or 300 vehicles a day, or where some form of bituminous binder was used, more assistance should be given.

Planning Ontario's Highways

Mr. W. A. McLean, replying said that he had studied the road organizations of other countries and other states and found none better than Ontario's. Nor did he know of any offering more generous terms of assistance to the municipalities. Neither was there any state which had worked out an equal plan of highway improvement, with the exception, perhaps, of Wisconsin. In Ontario they were picking out the main thoroughfares with a view to systematic expenditure, the money to be spent first where the traffic is heaviest, gradually extending all the work into a connected scheme. There had been much misunderstanding because one piece of work, as in the case of the Toronto-Hamilton Highway, was supposed by some to be standard for the Department. In some cases they would have to use a pavement of similar type; for instance, on the Ottawa-Prescott highway, but on other sections, as between Port Hope and Trenton, there has been considerable expenditure in gravelling and a slight improvement would make the road quite good enough for present traffic. The idea was to lay the heaviest type of pavement only where absolutely necessary, but in the first place to establish a system of maintenance and up-keep. It was believed by some that the Department was undertaking an immense programme which would involve very great expenditures and this was the origin of protests in certain quarters. However, there was no part of the continent that could proceed more safely than Ontario with the undertaking of a comprehensive highway scheme. It had to be financed annually and if debenture issues were necessary that was something that the Province could stand as well as municipalities.

Provincial-County Roads

Mr. G. R. Marston, county engineer of Norfolk, next took up the discussion. In the matter of provincial-county roads, he said he did not believe the extra assistance on such roads in his county was going to save them a dollar, but then they would have better roads. He made the suggestion that a further step should be taken in the centralization of the highway

administration of the province and commission, something along the lines of the Hydro-electric Power Commission of Ontario, formed, outside the influence of politics. His remarks proceeded as follows:

If you look in the dictionary you will find that the word "organization" is interpreted as the act of organizing or forming of bodies, and Ontario's highway organization at the present is organizing or forming a system of highways throughout the province of Ontario. The governing body of this organization must naturally be the Legislature, who must lay the foundation stone, as it were, for this road system by providing the necessary laws by which the organization may proceed with its works. Next in importance is the Highway Department, with the Minister of Public Works at its head, with our worthy chairman, Mr. McLean, as Deputy Minister, next in command, and I would ask you to remember that our entire organization depends more to-day on the Deputy Minister than on anyone else, for while the Minister of Public Works may change with a change of government, the position of Deputy Minister is beyond the realm of party politics; and, therefore, really directs the whole of the organization. Coming under his direct control is the staff of the department, then the county councils of the different counties act in a legislative way in regard to controlling and constructing certain roads within the counties in which they preside. Then come the road superintendents of the counties, and I would like to remind you that you are an important branch of this great organization, for you are above, or should be above, the realm of politics—following with the township councils and township road superintendents, and lastly, the abomination of all road organizations, the statute labor, performed or not performed, throughout the province.

History of Road Construction

It would indeed be interesting could we go back into history and learn something of the organization under which some of the roads constructed more than 2,000 years ago, and again, during the time of the Roman Empire, and later in France during the 16th century, when such strides were made in road construction. This we do know, that all this vast construction of roads in the past has been practically for one purpose, and that was for military purposes, and we know that these old roads in France were in a great measure responsible for the winning of the great war. These old military roads in France have made it possible for us to meet here to-day for the purpose of discussing the construction of roads, not from a military standpoint, but from a commercial standpoint.

Now we may turn our attention to the development of highways which are required to take care of the ever increasing traffic which is developing throughout the country. Highways must be built to accommodate the requirements of the farmer, the congested state of our railroads must be relieved by transporting the materials over the highway by means of the motor truck, thereby benefiting the manufacturers, and at the same time highways must be built to assist the farmer in reaching a market where he can dispose of his produce.

Value of Organization

In order that the greatest good should be derived from Ontario's highway organization, there must be unity among the various bodies composing the component parts of the organization. It was suggested

by Mr. McLean last year at the previous meeting of this convention, that here was an opportunity to discuss the various ways and means of improving the various Acts of Parliament, and I wish to impress upon you that far more good will come if the various bodies of this organization bring to the notice of this convention and to the notice of the Deputy Minister of Highways, any alterations which are required in the statutes which govern the organization—instead of circulating broadcast throughout the province copies of resolutions to be sent in by the various county councils to the Legislature. I am referring particularly at the present time to two resolutions which were sent to the various county councils during the winter, the one from Prince Edward County, and the other from Hastings County.

I have not much to say in regard to the resolution of the County of Hastings, other than that it seems to me to be a direct attack on the ability of the engineering staff of this organization, who have made a study of the requirements of the traffic, and through you, Mr. Chairman, the Act respecting the load of vehicles was brought forward and passed by the Legislature. I believe, gentlemen, there are other engineers here to-day who will tell you that if the roads are constructed in accordance with the regulations that the width of tire mentioned in the Load of Vehicles Act is sufficient.

Prince Edward County Resolution

Now passing to the resolution of the County of Prince Edward, which was circulated throughout the various counties during the past winter, asking that councils pass it as already prepared. I submit that the resolution, in the first instance, is an attempt to override the Highways Department, and, in the second instance, it was a direct insult to their own road superintendent, since after the Legislature, through the Highway Department, had amended the Highway Act, giving the superintendent power to initiate proceedings under the Ditches and Water Courses Act, the county council clearly says road superintendents are not capable of securing the outlets. Supposing you have a divisional engineer, he could not be granted any more power than the superintendent, unless a radical change were made in the drainage acts, and it would not seem reasonable to me that the persons living along the county roads should not have equal rights in regard to drainage matters with those living back from the county highway. I submit that such resolutions as these tend to disorganize, and not to organize the highways of Ontario.

The resolution was as follows:

That in order to secure a uniform standard of construction it is necessary to have more frequent inspection and closer supervision of the work on county highways by the Department, and whereas it is inexpedient and inadvisable to place the power to secure proper outlets for drainage across lands adjoining county highways in the hands of the county road superintendents—

Therefore, your petitioners pray that the Act to aid in improvement of public highways be amended so as to provide for the division of the counties operating under the authority of the aforesaid Act into county highway districts; that a divisional engineer be appointed over each district and that said engineer shall have control of the standard of construction in each county in his district, as well as authority under the provisions of the Municipal Drainage Act to secure proper outlets necessary to provide proper drainage

of all county roads under his charge, and who shall act under instructions from the Deputy Minister of Public Highways.

There is another matter to which I would like to draw your attention.

The Statute Labor Act is distinctly unfair, and I would like to ask the members of this convention to express themselves as to how they consider that this unfairness can be eliminated. For my part I would like to see the Statute Labor Act abolished completely, and let the township councils raise the money by direct taxation for the requirements of the roads.

Mr. McLean, in regard to Mr. Marston's reference to politics and roads, said that, in his opinion, the attitude always taken by the Ontario Department was that good business was good politics. There was no county in Ontario, he declared, that can say that because of political representation there had been discrimination.

Highway Laws Satisfactory

Mr. F. A. Senecal, county road superintendent of Prescott and Russell, expressed the view that there was not much improvement that could be made in the Ontario highway laws, and that they had better wait to find something wrong before changing.

Mr. R. H. Fair, Frontenac county superintendent, took Mr. Wheelock's attitude that on provincial-county roads where there was excessively heavy traffic, there should be some arrangement for an increased grant. As to the work of the Suburban Area Commissions, he said the county engineer was called in on this work and found it a considerable burden, there being new sets of accounts, etc., but no provision was made for any further remuneration on this account.

Statute Labor System Unfair

County Engineer Talbot, of Middlesex, emphatically denounced the statute labor system as being unfair and inequitable and declared that it should be abolished.

Superintendent Watters, of Lanark county, was of the same opinion in regard to the statute labor.

Mr. Talbot made reference to the condition in connection with the suburban area around London, where the city refused to pay its share and the Suburban Area Commission had ceased to act. The matter was being decided in the courts, but in the meantime no attention was being given the roads.

Mr. T. R. Allison, Wentworth county superintendent, said that the suburban area plan around the city of Hamilton had proved a success. Regarding increased grants to provincial-county highways, he believed any meddling with the Act would only cause trouble.

Mr. McClure, of Carleton county, referred to the purchase of material by the road superintendent. He said he had found he was only empowered to buy material by the yard, while there would be considerable saving if he could buy in bulk, and he thought the superintendent should be given this authority.

Mr. Milne, of Essex county, said they were having difficulty in regard to the suburban area around Windsor, as the city was refusing to pay its share, and the matter was likely to go to the courts.

Ditches and Watercourses Act

There was considerable discussion regarding the Ditches and Water Courses Act and the Municipal

Drainage Act. Mr. Marston expressed the opinion that the road superintendent should be empowered to institute proceedings under the Municipal Drainage as well as under the Ditches and Water Courses Act, as the latter could not be taken advantage of on projects costing over \$1,500. In reply to a question he stated that the drainage area was usually assessed for a percentage of the cost of culverts crossing roads, and the county for the balance. He thought there should be uniformity as to the amount assessed on each party.

Mr. Christie stated that the municipalities had the power to pass a by-law fixing the amount they would pay on culverts.

Mr. J. G. Cameron, of Dundas, Stormont and Glengarry counties, said they had no trouble in regard to securing drainage for the roads. The county authorities paid the full cost of culverts required and when they went to the people interested they were then not afraid of having to pay for this construction work.

Mr. McLean said it was felt that the county superintendent should have the power to sign for small schemes under the Ditches and Water Courses Act, but that the Warden should be empowered to sign under the Municipal Drainage Act, on resolution of the council. Regarding the suburban areas, some trouble had been expected, but it was only a matter of education. In England, France and the United States the cities shared equally with the counties in the expenditure on roads. Every road superintendent should be an agent in carrying on this educational work.

Purchase of Material

With reference to the Act in connection with the purchase of stone or gravel by the road superintendent, it was the intention at the present session of the Legislature to give the superintendent power to buy in bulk.

Mr. A. E. Watts, K.C., Clerk and Treasurer, of Brant county, thought the Act in regard to the suburban area should not be changed without good reason. The commission was working fairly well in the Brantford area. Where there was difficulty, he believed education was the only solution, but he wanted more data as to the percentage of the traffic arising from the cities, in order to convince the city dwellers that they were not being imposed upon. In regard to the revenue from automobile licenses, he believed it should be made quite clear that all the money would be devoted to road work and there would be no dissatisfaction. Similarly in the suburban areas, as soon as the town folk saw the results of their money in good roads they would be perfectly content.

Following Mr. Muir's paper, which appeared in our issue of March 5th, there were a number of slides, and also motion pictures showing the actual road building operations. In answer to a question regarding expansion joints in concrete roads, Mr. Muir stated that the practice had formerly been to place them every 25 or 30 ft., but now the distance had been increased in general, to 50 ft., and even up to 150 ft. Sometimes, too, the joints were omitted altogether.

Mr. D. T. Black, City Engineer of Welland, introduced the discussion on Mr. Muir's paper.

Mr. P. Robertson, county road superintendent of Lincoln, continued the discussion on Mr. Muir's paper, giving the experience in his county with bituminous surfaces. Up to 1916 they had nothing but water-bound macadam, and they spent \$30,000 a year

on 29 miles of this type of road. In that year they began to look around for something more permanent, and came to the conclusion that the bituminous surface road was practically the only one a county could build—other types of a permanent nature being too costly. So they built two miles of tar macadam, 18 ft. wide, with tile drain, curb and gutter. That road surface cost about \$19,000, being laid on an old water-bound macadam road. The old surface was not scarified, but the roller was run over it with spikes, then filled with new material and rolled till smooth. Four inches of new metal was used, with $1\frac{1}{2}$ gallons of the tar binder per square yard. Two-inch and one-inch stone was employed in the first course, with $\frac{3}{4}$ in. stone in the seal coat. Up till last August, when the Department took over the road after two years' travel, the county had spent nothing on it for maintenance and it was still in first class condition. The traffic on this road was very heavy, running from 1,000 up to 3,000 vehicles of all kinds, per day. Only in one spot did it break through, and that, which was evidently due to some dirt having been admitted in the construction, had not spread, though he had left it unrepaired to see what would be the result. Last year he had built another mile of tar macadam. Going over it different times during the winter, he had found it quite free from mud. It was 16 ft. wide and cost \$9,000. The foundation was 6 in. with 3 in. of the tar macadam surfacing. As a result of these trials, the county council has agreed that they are going to put down nothing but bituminous top roads all over the county, the water-bound macadam being too high in maintenance cost. They were planning to put down ten or twelve miles this year. He used a 3-inch wearing surface, with the foundation varying according to the weight of traffic.

In reply to a question from Mr. Christie, Mr. Robertson stated that the length of hauls of stone varied from $2\frac{1}{2}$ miles to $1\frac{1}{4}$ miles. Teamsters were paid \$7 per day, and the stone cost \$2.10 per yard at the station. The cost of the tar for one mile was \$2,400.

Mr. Phair pointed out that they must look to the most economical type of road. Sometimes the road which was cheaper in initial cost was dearer in the long run. He asked Mr. Muir what depth of macadam in an old road would be safe for bituminous surfacing.

Mr. Muir replied 3 in., with 8 in. of stone in the foundation. They were building a new macadam road this year 9 inches thick, leaving it for a year and then applying the bituminous top.

Mr. Robertson pointed out that the drawing of water for a water-bound road would pay for half the tar. He thought that if one had a good heavy roller it could be consolidated sufficiently in the first instance without leaving it for a year.

Mr. T. V. Anderson said the only objection to Mr. Robertson's method was that the macadam settled in waves.

Mr. Fair said it would need very careful work to roll a macadam road quite smooth at the time of construction, and he was rather in favor of leaving it to settle.

Mr. Robertson said that if the road did settle, it could be filled up without difficulty.

Mr. Allison advocated scarifying the macadam and putting on a little new material.

Mr. J. R. McQuigge, county road superintendent

of Renfrew, was to have presented a paper on "Rock Excavation, Quarrying and Crushing," but was unable to be present, and in his absence the subject was handled by Mr. W. Huber, of the Highway Department, who gave an address illustrated with lantern slides.

Rock Excavation, Quarrying and Crushing

Mr. Huber pointed out that there were a number of operations involved in quarrying and crushing—stripping the ground, drilling, mucking, blasting, delivery to the crusher and feeding the crusher. In many cases another important item for which provision must be made, was the drainage of the quarry. In the selection of a quarry, care should be taken to pick one in a location where the removal of water would be easy. The distance from the work is, of course, the main factor in the choice. A slide was shown, with a quarry on the side of the road, from which the stone required for construction was used for a stretch of about five miles. Another important consideration was accessibility. The ideal location is one where the quarry is practically at the road level. It is also often possible to locate it immediately on the road; by cutting out a hill one may reduce the grade and provide the stone required for the road.

In the arrangement of the plant in the quarry, the delivery of material to and from the crusher are important considerations. Efficiency would suggest that the crusher be placed somewhat below the bottom of the quarry, so that the hauling of the rock may not be too expensive. It is also necessary to place the plant so that it will not be damaged from the blasting.

Quarrying

In opening the quarry one of the first items of cost is that of drilling and blasting. To get reasonable return for this cost, a face of sufficient depth is required so that the drilling may be carried on to produce the greatest amount of material. Often the mistake is made of starting from the level of the ground and going down only a few feet. It is much better to go down from six to twelve feet, thus producing a great deal more material.

Another feature to be kept in mind is the keeping of the face vertical. By doing so there will be better results from the blasting and the men can work more efficiently.

It must also be remembered that no matter what kind of stone is being quarried, there will always be as much dirt in it after it passes through the crusher, as should be allowed for road-making purposes. Therefore, all possible dirt should be removed before quarrying is commenced.

Drilling

In regard to drilling, it is advisable to use a machine drill of some kind, as against a hand drill. There is the choice between steam and air drills. The steam driven implement can often be used to advantage where a steam engine is being employed to drive the crusher and there is the extra steam power available. On the other hand, steam is not so convenient to work with as compressed air, and small outfits of the latter type can be obtained at reasonable cost.

Crushing

In crushing, quarry stone and field stone must be taken into consideration as different problems. For

quarry work either a stationary or portable crusher may be used. In most county work, however, the portable outfit is employed, but where there is a good quarry in proximity to a number of roads, the stationary plant may be advantageous. In selecting a portable outfit, it is advisable not to purchase one that is too small. The largest is 10 in. x 20 in., with an average capacity of 100 yards per day, which may, however, be increased in the case of soft stone up to 120 yards. In the stationary outfit, a satisfactory size is 12 in. x 24 in., with about 200 yards capacity.

The feeding of the crusher is a most important item, as the output may be increased by efficient methods, while the cost of fuel remains the same.

Handling Stone at Crusher

In the handling of stone, the first method is that of raising it from wagons from a lower level than the crusher, which is somewhat expensive. Again, there is the method of raising the wagon to some height and bringing it up to the level of the crusher, so that the stone has only to be moved horizontally. One objection to this course is that the team is standing idle during the process of unloading, and it is a good idea to have an extra wagon for the team.

In some cases a platform is used to elevate the wagons. Possibly a more efficient method for the handling of stone is the use of one-horse dump carts, with a capacity of about a yard to a load, brought up an incline and dropped into the box or as near as possible to it, so that one man can feed it to the crusher. In this case it is hardly wise to have extra horses.

If the plant is up for a long enough period to justify the expense, the use of cars and tracks is very satisfactory, the cars being handled with a cable from a small hoisting drum driven from the crusher engine. A slide was shown, illustrating cars of the side dump variety, which dump directly into the crusher jaws. In this case one man can easily see to the feeding of the crusher.

Another method, where the crusher is at a lower level than the quarry, is to use double tracks, one on each side, so that two cars can follow each other without interference.

Sometimes it is advisable to place the crushing plant above the quarry altogether, and in that case a derrick can be used to advantage for the handling of the stone. One advantage of this arrangement is that there is no risk of damage to the plant; also the hauling of the material from the quarry will generally be down grade.

Crushing of Field Stone

Field stone has usually been collected for crushing. This preliminary work can usually be done most cheaply in the winter, as hauling can be more easily carried out, with bigger loads and more men are available. The use of field stone has the advantage that material can be delivered right at the road. It is advisable to have it placed at reasonably short intervals, in order that subsequent hauling may be reduced to a minimum. The quantity should therefore be estimated and placed at, say, intervals of a mile, the maximum haul being thus limited to half a mile.

One arrangement for crushing is to pile up the stone in rows about 8 ft. apart, leaving just room enough for the crusher to pass between. The objection is that the stone is carried piece by piece by man power to the crusher, and the cost of labor is bound to be excessive. Another point is that, while the crusher is theoretically supposed to be kept moving

down the row. it is not moved at very frequent intervals.

The better plan is to pile the stone in one large block, and handle it the same way as from a quarry. In crushing field stone, there is the problem of handling stones larger than the capacity of the crusher. One case was mentioned in which contractors were given a stone fence, free, for road purposes. Many of the stones, however, were too big for the crusher, and they had to use the "bull-dozing" method to break them, but in the end they found it cheaper to obtain their stone from a limestone quarry.

In the "bull-dozing" about a third of a stick of dynamite is placed on top of the stone and tamped with clay and then fired. The stones are not, as a rule, shattered, but can afterwards be easily broken with a hammer. Sometimes a small hole is drilled in the top of the stone and the charge placed in it, and perhaps this is the best way.

Discussion

Mr. Fair, in opening the discussion on Mr. Huber's talk, referred to the conditions in Frontenac. There was considerable granite and limestone appearing in a great many places throughout the county. In a great many places the granite appeared in large mounds on the roadway and had to be removed. The worst part of it was, however, that it was not suitable for road making purposes. In one case it had cost \$2.50 per yard to get it out. Where limestone appeared, he brought up the crusher and made a quarry out of the road, and he strongly recommended following this course.

In regard to quarrying, he warned against setting machinery up close to the face. In their operations in Frontenac, there had only been one case of damage being done to the crusher. The man in charge should be able to judge the distance back from the quarry face and the amount of the charge.

Delivery of Material

For delivery of the material, they had tried horse-hauling and wheelbarrows, and had finally decided on the use of cars. By the use of cars, and facing the crusher right towards the quarry, he had found they could, with a proper gang of men, keep the mouth of the crusher full for ten hours without a break, and in no other way had they got as good results. Any little rivalry among the men seemed to be helpful in increasing the speed of the work.

In breaking up field stone, he had found the greatest satisfaction in the use of dynamite by prying underneath with a bar and placing the stick of dynamite under it.

In the quarrying, he thought the best results were obtained if the charge was judged so that rock came out in a block not too badly shattered, and was broken up afterwards. In this way there was less waste and debris.

Mr. McVicar was in favor of using two sticks of dynamite, rather than only a part of a stick, as suggested by Mr. Huber, for breaking big stones. In quarrying, he thought black powder gave the best results. It has been his practice to drill down and chamber with dynamite and then use the black powder, which gave a greater upward pressure, while the dynamite struck down. He preferred to have a sufficient charge to heave the rock right out of the cut.

The final session opened with a paper on "County

Road Accounts" by K. W. McKay, county clerk of Elgin. This paper was largely an exposition of Elgin county's system of keeping time, labor and cost data, as applied to road construction and maintenance, including culverts and bridges. The keeping of accounts is facilitated by properly prepared record sheets, which make it possible to transfer the figures with the least possible labor. The Elgin county system embraces specially-prepared, conveniently-arranged maps for the use of the road superintendent, field note books and office books, in which all data can be readily entered, and from which the statement required by the Provincial Highways Department can be easily prepared. Mr. H. D. Cleminson, county road superintendent, in discussing this paper, mentioned the importance of a properly arranged system of keeping accounts, and declared that the simpler it was, the better. He had discovered the advantages of a well-equipped office for the superintendent, with telephone connection to each foreman. Mr. Cleminson further advocated the preparation of the whole road organization early in the season to avoid waste of valuable time. A uniform system of account keeping was urgently necessary in his opinion.

A system that must not be too expensive, was Mr. Watt's comment. It was possible, he said, to have the accounting so complicated that the expense would be abnormal. A satisfactory system must appeal to the ratepayers as well as the road superintendent and county treasurer.

The session was closed by the reading of two papers: "Snow Fences and Snow Removal," by S. A. Cummingford, chief engineer, Toronto-Hamilton Highway Commission, and "Specifications and Contracts" by E. A. James, engineer to the Toronto and York Roads Commission, Toronto.

The Public Works Committee, of Guelph, Ont., has recommended the following resolution for adoption:

That this council petition the Legislature to amend, next session, those sections of the Ontario Highways Act, 1915, respecting the construction of suburban roads in the following particulars:—

That cities and towns of 10,000 population or over shall have the right of election of entering into such a commission and at fixed intervals of three years, the right of withdrawal;

That unless the Legislature concedes previous point of election as to entering, the third member of the commission be the city or town engineer.

That the term of office should, in our opinion, be three, instead of five years. When a commissioner or commission does satisfactory work, he or it will be re-appointed. If the work is not satisfactory, the term is too long. Provision is now made for the removal of the city's or town's and of the county's appointee, but the commissioner chosen by these two is irrevocable, for five years.

That some form of direct control of expenditure is needed, otherwise public monies may be frittered away on cutting weeds and like trifling operations, under the name of repairs. That 25 per cent. of the motor car tax collected in any city or town adopting the suburban Good Roads Commission, be returned to such municipality, on condition that fifty per cent. of the sum so received shall be expended on suburban roads and the other fifty per cent. on urban roads.

How Toronto-Hamilton Highway Commission Fought the Snow

By Mr. S. A. Cummiford*



Mr. S. A. Cummiford

THE constant increase in the numbers of motor vehicles in use and particularly commercial vehicles, is making the question of keeping our roads open for traffic the entire year, of first importance. The worst thing we have to contend with in Ontario is snow, and lately there has been considerable investigation as to the most economical and effective methods of snow removal.

The methods used and the expenditure necessary depend upon the class and the amount of traffic to be provided for. The traffic may be divided into three classes:

"A" Entirely Motor, which means removing all the snow.

"B" Largely motor with some horsedrawn sleighs. In this case a minimum depth of 4 inches of snow should be left.

"C" Entirely Team. For this class of traffic probably very little snow need be removed except where local conditions have produced drifts.

On some of the roads in the United States good results have been obtained by using a plow in front of a motor truck for depths up to 18 inches, and on less important roads, rollers have been used. When the depth of snow exceeds 18 inches practically the only method is hand removal.

Grades on Toronto-Hamilton Road

The snowfall last winter was the heaviest we have had for years and probably a short description of the methods used in keeping the Toronto and Hamilton Highway open would be of interest. Ordinary road graders were largely used for this purpose and they proved quite satisfactory where the depth of snow was not too great and where it had not drifted. Four graders were employed and stationed at the following points: New Toronto, Clarksons, Bronte and Aldershot. The graders were left with farmers living along the road, and the arrangements had been made with them to supply teams and operate the machines whenever necessary. About 4 inches of snow were left in the road and this made excellent sleighing. Heavy drifts had to be shovelled by hand, and I might say that a considerable amount of this was done.

One of the worst places for drifts was near Clarksons and we finally decided to protect this part of the road with snow fence. This was constructed in 12 ft. sections. Seven boards 1 inch thick by 6 inches wide, with 3 inch spacing were nailed to two pieces of 2 inch by 4 inch, 6 feet long, which formed the ends of the section. The 2 x 4's extend 6 inches above and below the top and bottom boards respectively. In the first fence that we had manufactured one vertical piece 1 inch by 6 inches, 5 feet 6 inches long was placed in the centre of the section, but afterwards this was changed and two vertical pieces of the same

size were used and spaced 4 feet centre to centre. This arrangement made the fence more rigid.

The first amount of snow fence purchased was 1000 feet. This was placed at the points where the heaviest drifts formed. Unfortunately it was late in January when the fence was received and the snow was already deep so that we did not get the benefit that we would have if it had been erected early in the winter. A careful note was made of places where continual drifting occurred and last fall an additional 392 sections or 4,704 feet of fence were secured and erected.

A ½-inch bolt passes through 2 x 4's above the top board and fastens the sections together. The bottom of the fence is staked and wired. Generally the fence is placed from 80 to 100 feet from the road so that the drift forms at the fence and runs out before the road is reached.

To the best of my knowledge snow fences have not been used to any great extent for the protection of highways. It has been used by railroads for some time with good results. The Toronto and York Radial Railway Company have some ten miles of snow fence in use along Yonge Street on the Metropolitan division. This protects about 50 miles of track and has proved very satisfactory. I can see no reason why snow fences should not be used for the protection of our highways.

Our snow fighting equipment also includes a snow plow. It is much the same as those used to keep lumber roads open, except that the rutting attachment is not used and that the plow is rather wider than those used for sleighs. Wings are provided to throw the snow well back from the road. The plow is intended to be drawn by horses, but we expected to try hauling it with a tractor this winter. Up to the present time there has been no opportunity.

The total cost of snow removal last winter was \$2,560.57 or \$72.13 per mile. You must remember that the snow fall was exceptionally heavy and that a great amount of hand shovelling was done. Our records show that there were ten days during the entire winter when it was impossible to get through from Toronto to Hamilton.

Canadian Steel Corporation's Plant

The construction work on the Canadian Steel Corporation's plant at Ojibway, Ont., is likely to be pushed this season with considerably greater speed than was possible during the war. Good progress has already been made in getting the property into shape for the erection of the various units, drains and underground work to a value of hundreds of thousands of dollars having been constructed. The most modern dock facilities are also being provided, and on this part of the undertaking the foundations of the concrete work are about 75 ft. below the surface at bed-rock. The walls on the westerly side of the docks are further advanced than on the easterly side. The outer wall is connected with a second concrete wall by a series of reinforced concrete beams placed at 30-foot intervals. The second wall is in turn secured to a third wall by steel concrete beams at 60-foot intervals.

*Chief Engineer of the Toronto-Hamilton Highway Commission, before Ontario Conference on Road Construction.

Ice Breakers at Three-Rivers Shipyard Co.

THE Three-Rivers Shipyard Ltd. was organized in 1917 to build wooden ships for the Imperial Munitions Board. During 1918, The National Shipbuilding Co., Ltd., an American concern, took control of this and completed two wooden cargo boats on the bed ways at the time. Since this company has re-organized and expanded considerably, making the following additions to their plant: New general office; tool store; mill and mold loft room; Blacksmith and repair shop. All of these are one and a half storey in height and are wooden frame buildings. The shipyard was extended westward by adding to

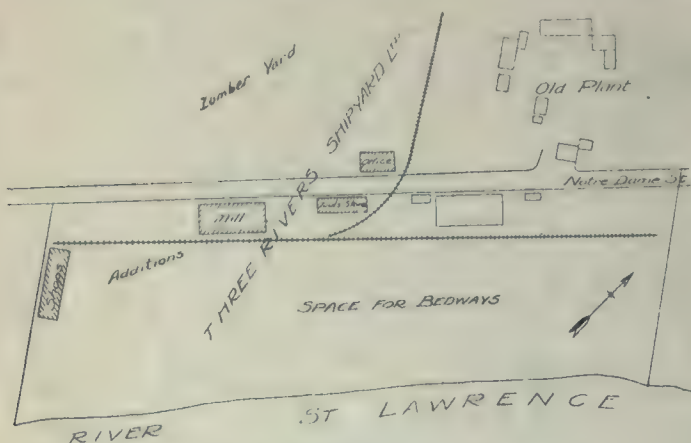
teet the boats on the slips as well as the wooden structures in the shipyard. This portion of the bank is exposed to the ice coming down the River St. Lawrence during the freshets. There are large, solid ice-floes carried down from the Lake St. Peter, which have not been completely broken up by the action of the waves, etc., before reaching this point.

During November last the company applied to the Government of Canada to secure a permit to carry on construction under the Act of Navigable Waters. This request was made through their Attorneys-at-Law, Messrs. Bureau, Bigue and Gariépy, of Three-Rivers, P.Q. Since then the company has proceeded on this protection work which is located west of their property and runs along a straight line at right angles to the River St. Lawrence. The work consists of three piers, each 20 feet wide by 30 feet long, and an average height of eighteen feet. They are constructed of round timber, nine inches at the smallest end. They are of open joint and the vertical posts are of the same timbers as the longitudinals and cross-ties. The ballast floor is made of six-inch round timber. Spruce and hemlock has been used throughout and one man stone is used for the ballast.

The work has been designed by the company's engineer and Mr. O. Arcand, civil engineer and general contractor, Three-Rivers, is the contractor on this job.

Good Roads Expenditures

Replying to an inquiry of the Contract Record regarding the amount of money likely to be spent on Ontario roads during the present year, Hon. Findlay Macdarmid, Minister of Public Works and Highways, states that the exact amount cannot be definitely named until the county by-laws have all been submitted to the department for approval. Judging from reports which have appeared in the newspapers as to the amount the different counties are contemplating, the Minister give it as his personal opinion that, in the aggregate, the counties would pledge themselves to an expenditure of between \$3,500,000 and \$4,000,000. The government contributes 40 per cent. on county roads and 60 per cent. on county provincial roads, so that the government expenditure under the county system, if the above estimate proves correct for the present year, would amount to a sum in the neighborhood of \$1,500,000—a total of \$5,500,000.



Block Plan of Three Rivers Shipyard Limited

their property an adjoining farm. These improvements are now completed. The work on the building has been done by day labour by the company's men under the supervision of Mr. Jules Caron, architect, 69 St. Francois Xavier Street, Three-Rivers, who designed the work.

This shipyard is located on the western side of Three-Rivers, on a property adjacent to the new coal dock. The site has an elevation some twenty feet above the lowest water mark, and is exposed to the action of floating ice in the spring. This is the company's reason for deciding to build ice-breakers to pro-



View showing method of constructing ice-breakers

Montreal Branch of Association of Canadian Building and Construction Industries Hold First Banquet

THE Association of Montreal Building and Construction Industries, formerly known as the Builders' Exchange, had a splendid send off, at the first banquet at the Windsor Hotel Montreal, on the evening of February 27. There was an attendance of about 170, representing every branch of the contracting and building industries, in addition to representatives of the engineering and architectural professions.

The Montreal Association has been organized for some time, but the banquet was intended to formally inaugurate the association. The speeches were excellent, short and to the point. The speech of the evening was made by the Hon. Charles Marcil, member of the Montreal Administrative Commission, who in eloquent terms replied for "Our Country."

Mr. W. M. Irving presided, and after the toast of "The King" extended a hearty welcome to the guests.

"Our Industry" was proposed by Mr. W. E. Ramsay, who insisted upon the value of co-operation and enthusiasm. When, he said, it was decided to organize the National Association they had no idea that their efforts would be crowned with such success. If they achieved one-quarter of the aims set forth the Association would not have been in vain.

In responding, Mr. J. P. Anglin, the president of the Association of Canadian Building & Construction Industries, remarked that when he accepted this position he had no idea of the amount of work it would entail. When they realized that the building trade was second in point of numbers employed in the industries of Canada, they would see what a vast industry it was. The Ottawa Conference was really only a beginning; but it would expand if the industry supported it financially as well as by membership. It was essential that support should be given by the prominent members of the industry. At the first council meeting of the Association, to be held in Toronto, the constitution would be completed. Sherbrooke had organized a branch and the Toronto Builders' Exchange had re-organized. It was expected that the Association would become truly national, with branches in all the principal cities. Next week it was hoped to select a secretary from 300 applications, and to open an office in Ottawa. He regarded it as essential that the headquarters should be in the capital. The question of organizing industries had come home to all much stronger since the war. Mr. Anglin then touched on the housing question, and said he hoped that no time would be lost in Quebec in framing a scheme so as to be able to get to work. In Montreal the housing question was bound up with other civic reforms, and he suggested that the City Improvement League, Engineering Institute of Canada, the Provincial Association of Architects, and their own Association, should get together and work out a definite plan of housing. He looked forward with a great deal of expectation to the development of the building trade; he believed that the period on which we had just en-

tered would be one of the best periods which Canada had ever seen. He would not recommend anyone to put off building until costs decreased. As they were aware, the increase in the cost of building had not been as great as in other lines. Prices of material, he believed, would not come down to any extent. Steel was already cheaper, but lumber would not drop in value. There was indeed a possibility that when building started in earnest prices would stiffen, because suppliers of material had been working on a small margin and some had lost money. Even if building cost a little more it was better to start now and to have the benefit of the structures rather than to wait. He was anxious for the industry to be stabilized, and it was only by united action that this could be accomplished.

Mr. W. Rutherford proposed "Our Guests," which was responded to by Mr. Norman MacVicar, vice-president of the Province of Quebec Association of Architects. There were, he said, occasions on which the contractors were not anxious to meet the architects. This was not one of them. When the Association sent out the invitation to the architects to be represented that evening, they omitted the usual clause that "the lowest or any deputation not necessarily accepted." Many recollected the time in Montreal when there was no Builders' or Architects' Associations, and the relations were not always the most cordial. This had been changed, largely owing to the efforts of the Builders' Exchange. Architects and contractors were important factors in their civilization, exercising a considerable influence upon the health and morals of the community. There was the closest relationship between good housing and environment and the making of good citizens. It was therefore the duty of all interested in the welfare of the country to support the housing scheme of the government, and organizations of this kind could render real service in the period of reconstruction. He regarded the outlook as good, as they had before them possibilities of a great industrial expansion, in which the contracting industry would share.

Mr. W. J. Francis, vice-president of the Engineering Institute of Canada, spoke of the recent development of that society. He also referred to the splendid service by engineers at the front, mentioning that 36 per cent. of the membership of the Institute had enlisted, and had won all honors, including the V.C. They were especially proud of the records of Col. A. Dubuc and Col. Mitchell. Mr. Francis then alluded to the unpardonable delay in dealing with the Montreal building by-laws which were hopelessly out of date, and he hoped that steps would be taken to put into force a new code.

Mr. John Baillie, president of the Board of Trade, and Ald. L. Rubenstein, for the mayor, also replied.

"Our Country," the last toast, was proposed by Mr. James Ballantyne, who declared himself an optimist as to the future. There was, he said, no reason why building should not commence on a good scale

right away. We might have a small reduction in materials and labor, but it did not look that way at present. The government programme of construction would help relieve the labor situation, and there was certainly need for a large amount of work to be done. While he welcomed the announcement of the proposed loaning by the government of money at 5 per cent for housing purposes, he was rather sceptical as to whether the smaller municipalities would be willing to add to their burden of debt.

The Hon. C. Marcell replied. First of all he dealt with Montreal's civic problems, including housing, stating that the commissioners were trying to introduce sane methods of government. The speaker then gave a historical sketch of the growth of Canada—a wonderful romance, he termed it. In picturesque language he briefly described the work of the first settlers, also touching on Confederation, and the results which had followed. Canada, as a nation, now stood in a position of which no man dreamed five years ago. She had done nobly in the war. The League of Nations conceived by President Wilson had long existed within the confines of the British Empire. Canada's position had been won at a tremendous cost of tears and blood, as the price of liberty. There would be a tremendous increase in the national debt, but this would be in accordance with the growth in national sentiment, even though Canada's national debt amounted in the near future to something like two billions of dollars.

Mr. F. W. Dakin, of the Sherbrooke Builders' Exchange, and Mr. M. Brosseau, president of the Quebec Builders' Exchange, also briefly spoke, the latter suggesting that a representative of the Association should visit Quebec and assist in the work of expanding the activities of the Exchange there.

In addition to the speakers referred to above, there were present as guests Messrs. G. A. Monette, and Hugh Vallance, of the Architects' Association; Frank Pauze, of the Chambre de Commerce; and the following past presidents of the Montreal Builders' Exchange—Messrs. J. Quinlan, Gagnon, and Gilday.

Strengthen the Weakest Link!—The Small Bridge

THAT is the weakest link in the average country road? What is the link that can be destroyed by nature's forces—wind, fire, frost, water or rust?

The answer is the small bridge over the creek or marsh. This is the stand taken by M. J. D. Frazer in a recent issue of *The Highway Magazine*. The average country road is not essentially a pleasure pike. It is used for a purpose, and when it fails to be useful, that purpose is defeated. When a bridge breaks down it does so either from natural causes, or from the weight of a vehicle passing over it. Perhaps the vehicle is loaded with produce for the market; perhaps it is carrying necessities for the farm. In either case delay may mean a serious financial loss.

A bridge that may suddenly give way has no place on the road which serves the communities it connects. If it is rickety, it should be replaced, and when it is replaced, it should be built of materials which will not fail to stand up under increasingly heavy traffic. It should be built of materials which resist the destructive forces of nature and the weight of traffic.

There is sometimes a tendency to repair the small

structure which carries the road across a creek or swampy spot, and replace the bridge that spans the wide river or marsh. This is due in many cases to the fact that the big bridge seems the most important because without it the road would be impassable. But the small bridge is just as much a part of the road, and its failure may mean that traffic will be stopped and injury done to property.

There is a feeling, too, that the big bridge over the river must be built of the best materials, as its sudden failure would mean death to those crossing it. This is doubtless true, and, therefore, it is right that a large amount of money should be spent on the one or two big structures crossing streams along the line of highway. But this does not mean that the small structures should be neglected, or replaced with unsuitable materials.

Therefore, it is necessary when choosing materials for building the numerous small bridges to select those which offer resistance to wind, fire, water, frost, rust and pressure, and which are not prohibitive price.

The time element also enters. Traffic is, of course, blocked when the big bridges are being built, as steel and concrete take time to install, and, therefore, the work of replacing the small structures should obviously not make like demands upon the time of those using the road.

Then, too, there is the question of labor. Now that labor is scarce and expensive the bridge should be built as quickly and by as few men as possible.

War-time necessity has seen the introduction of a new destructive force working against the life of the small bridge. It is the large volume of commercial motor traffic with its heavy loads. Peacetime prosperity will see the development of a vast system of motor expresses, operating over the roads of the country from coast to coast. Every road, whether good or bad at the present time, that connects the farm and market or industrial centers, will ultimately be improved and carry its share of the load.

Already the highways of the United States and Canada are beginning to feel the effects of this new means of transportation. Manufacturers have found that they can ship goods cheaper, and as a result sell them at a lower price, if they use the motor transport for short hauls. War-time railroad congestion forced them to adopt the plan, and it has proved a money saver. Farmers, especially in the East, have found that they can get their produce to market more quickly, and thus prevent its spoiling en route, if they use the motor truck instead of the railroad car.

This activity means that roads must, and will, be improved. And with the improvement of roads, comes the improvement of bridges. A bridge constructed of materials which will stand up under the load of increased traffic, and resist the destructive forces of man and nature, will be the bridge of the future. And those who build highways should look forward and strengthen the weakest link in the road—the small bridge.

James, Loudon & Hertzberg, Limited, the well-known firm of consulting engineers, have added another department to their business, namely architecture. Mr. Harold R. Watson, B.A.Sc., has been engaged to take charge of this department. The intention of the firm is to specialize in the architectural work of engineering structures and also a general architectural practice.

B. C. Good Roads Executive Meets

At a meeting of the executive of the Good Roads League of British Columbia recently, a number of resolutions were passed which are intended to bring to the attention of the provincial government measures which are considered necessary in connection with highway improvement in the province. One of the resolutions was:

That in order to cope with the unemployment situation and recognizing the desirability of carrying on public works of a revenue producing nature, such as highways, it be suggested to the provincial government that \$5,000,000 of a twenty-year loan be obtained from the Dominion authorities, the revenue from the B. C. automobile owners to be earmarked for the repayment of the loan, and loan to be applied to the roads of the province.

Another resolution advocated co-operative action between Victoria and Ottawa for the construction of a Canadian highway. Other resolutions urged the construction or completion of a number of roads: From Vancouver and New Westminster to Agassiz on the north side of the Fraser and from New Westminster to Rosedale on the south side of the river; from Cascade to Rossland; from Creston to Salmo; repairs to Clark road between New Westminster and Port Moody; completion of One Mile Creek road, between Merritt and Princeton; hardsurfacing road from north shore ferry to Capilano Canyon and Capilano; 16-mile road from Taft to Boulder to Mara; extension of Fort Fraser road to connect with road system of the Bulkley Valley; hardsurfacing the Canadian highway through the city of Chilliwack; the construction of a coast interior road as part of a Canadian highway, construction to begin not later than May 1, 1919, either by way of the Hope-Princeton route or the Yale-Spence's Bridge route; paving of Island Highway from Craigflower bridge to Parson's bridge; paving of Pacific highway from New Westminster to Blaine; construction of a road from Jordan river to Port Renfrew, and from Campbell river to Salmon river, and also the repairing of the Vancouver Island highway at various points. It was also urged that the government take action to change the rule of the road to have it conform to that generally in effect throughout the Dominion.

Prize Essay Contest in Industrial Economics

The National Industrial Conference Board offers a prize of \$1,000 for the best monograph on any one of the following subjects:

1. A practicable plan for representation of workers in determining conditions of work and for prevention of industrial disputes.
2. The major causes of unemployment and how to minimize them.
3. How can efficiency of workers be so increased as to make high wage rates economically practicable?
4. Should the State interfere in the determination of wage rates?
5. Should rates of wages be definitely based on the cost of living?
6. How can present systems of wage payments be so perfected and supplemented as to be most conducive to individual efficiency and to the contentment of workers?

7. The closed union shop versus the open shop; their social and economic value compared.
8. Should trade unions and employers' associations be made legally responsible?

The contest is open without restriction to all persons except those who are members of or identified with the National Industrial Conference Board.

Contestants are not limited to papers of any length but they should not be unduly expanded. Especial weight will be given to English and to skill in exposition.

Each competitor should sign his manuscript with an assumed name, sending his true name and address in a sealed envelope superscribed with his assumed name. No manuscript will be accepted the real authorship of which is disclosed when the manuscript is received by the Board, nor any which has been previously published in any way.

Manuscripts, to be considered in the contest, must be mailed on or before July 1, 1919, to the National Industrial Conference Board, 15 Beacon Street, Boston, Massachusetts, marked "For Prize Essay Contest in Industrial Economics."

S. P. S. War Scholarships

The Faculty of Applied Science and Engineering of the University of Toronto has awarded war scholarships as follows:

First-class scholarships of \$100 per annum for four years—E. V. Ahara, H. M. Dilworth, A. H. Heatley, H. G. Hayman.

Second-class scholarships of \$50 per annum for four years—C. D. Pearson, R. R. McLaughlin, M. V. Powell, G. E. McLean.

Scholarships were provided, originally, by Engineering Alumni Association of Toronto University for the main purpose of attracting students into the engineering profession for subsequent military service in France. It is now proposed to maintain these scholarships to stimulate interest in engineering work as applied to problems of reconstruction and the development of industry and natural resources.

The draft estimates of the Toronto civic works department total \$5,433,851, as compared with \$1,882,401 last year. The summary is as follows:

Maintenance	\$1,814,780.00
Marine section	15,000.00
Civic Railway	430,610.00
Garage	14,875.00
Insurance	44,434.00
Workmen's Compensation	7,500.00
Special items	316,067.00
Capital expenditure	2,790,585.00

Total..... \$5,433,851.00

Below is a summary of the proposed capital expenditures:

Sewer section	\$503,585.00
Railway and Bridge section	115,000.00
Civic Railway	200,000.00
Water Works—	
Supply	121,000.00
Main Extension	1,851,000.00

Total..... \$2,790,585.00

Drainage Works on Railway Lands

By Mr. G. A. McCubbin*

THE necessity for distinguishing between railway lands and the lands and roads of private or municipal owners in working out provisions of the Ontario drainage laws arises from the fact that nearly all railways are created and controlled by the Dominion Government, while the municipalities and the drainage laws which they are empowered to set in motion, are under control of the Provincial Government. In the matter of direct taxation, the authority of the Province extends to railway lands and companies equally with other lands and their owners, and consequently, in so far as assessment alone is considered, there has never been any occasion to exclude railway lands from a fair schedule of assessment to meet the cost of a properly authorized municipal drainage work. But when it becomes necessary to enter upon railway lands for the purpose of constructing any drainage work thereon, the authority for such work cannot be given by the Province, but must come through Dominion legislation, either by itself or in conjunction with the laws of the Province.

Railways Same as Private Owners

Previous to the year 1903 private ditches, award ditches and municipal drains, or crossings for the same, could be constructed on railway lands only by agreement with the railway companies, the usual agreement providing for the work to be done by the railway and the cost to be borne by the municipality or the individual. In the year 1903 very important amendments were made to the Dominion Railway Act, (Sections 250 and 251) in respect to drainage. Section 251, with which we are more particularly concerned, is:

"1. Whenever by virtue of any Act of any province through which the railway runs, proceedings may be had or taken by any municipality or landowner for any drainage or drainage works, upon and across the property of any other land owner in such province, the like proceedings may, at the option of such municipality or land-owner, be had or taken by such municipality or landowner for drainage, or drainage works, upon and across the railway and lands of the company, in the place of the proceedings before the Board in the last preceding section provided.

"2. In case of any such proceedings the drainage laws of the province shall, subject to any previous order or direction of the Board made or given with respect to drainage of the same lands, apply to the lands of the company upon or across which such drainage is required, to the same extent as to the lands of any landowner in such province: Provided that the company shall have the option of constructing the portion of any drain or drainage work, required to be constructed, upon, along, under or across its railway or lands.

"3. In the event of the company not exercising such option, and completing such work within a reasonable time, and without any unnecessary delay, such work may be constructed or completed in the same manner as any other portions of such work are provided under the laws of such province to be constructed.

"4. Notwithstanding anything in this section contained, no drainage works shall be constructed or re-constructed upon, along, under or across the railway or lands of the

company, until the character of such works, or the specifications or plans thereof, have been first submitted to and approved of by the Board.

"5. The proportion of the cost of the drain, or drainage works across or upon the railway, to be borne by the company, shall, in all cases, be based upon the increase of cost of such work caused by the construction and operation of the railway."

It is interesting to note in passing, that this legislation was introduced into the House of Commons by a member who had been counsel for several municipalities in litigation against the railways, but who became, shortly after the passing of these provisions, a leading counsel of one of the great railway corporations.

No Power of Appeal

The effect of these amendments was to put railway companies in the same position as private owners and with practically the same limited rights; there was no power of appeal against any municipal drainage scheme recommended by an engineer and adopted by a township council excepting under Section 9 of the Drainage Act, which deals with disposal of excavated material and similar matters of individual rights. The only protection that the railway company had against having an ill-considered and perhaps unnecessary and expensive scheme forced upon it was by objection taken before the Railway Board when the Board's approval of the work was sought by the municipality. Under the Ditches and Watercourses Act they might appeal to the County Judge, who had full authority to modify or quash an engineer's award, but any such appeals of railway companies to County Judges have been very rare.

The railway companies were thus placed in a rather difficult position, at least in so far as the municipal drains were concerned. The Railway Board did not choose to review all the merits and demerits of a drainage scheme initiated under provincial laws, taking the view that such matters should be dealt with by the various tribunals created by the Province for this express purpose, and that the Board should deal only with such features of the work as affected the safe operation of the railway. Where a railway company sought for the modification of a proposed drainage scheme through appeal to the drainage referee, the referee was forced to hold that the company was only in the position of a private owner and had no right to attack the general character of the proposed drainage scheme. In one case a railway company went first to the Board and afterwards to the Referee, but for the reasons above stated was unable to obtain before either tribunal a trial of their appeal to prevent the work being carried across their lands. An amendment to the Drainage Act in 1912 (Section 101a) gave the railway company in cases of this kind the status of a non-initiating municipality, in that it became necessary for the council of the initiating municipality to serve the railway company with reports, plans and specifications of any proposed work on the railway lands, and the company was given the right of appeal against the same to the drainage referee, but at the

*At the Ontario Land Surveyors' Association Convention.

same time was made responsible for the costs of appeal regardless of the result in other respects.

The engineer, who is properly authorized either under the Ditches and Watercourses Act or under the Municipal Act to enter upon railway lands and lay out drainage works thereon, should bear in mind that in this, as in all other matters, his functions are judicial, and he must be absolutely impartial as between the railway company on the one hand and the private owners or municipality on the other hand. He should consider carefully to what extent, if at all, it is necessary to construct drains either along or across the railways. In the first place the fact that a right of way may be one hundred feet wide and that only a fraction of this is used for a single or double track road, does not mean that the remaining strip of land on either side of the track is to be utilized for the construction of drains merely to save so much of the land of the adjoining owners as would otherwise be taken for the purpose; the right of way is intended for railway purposes and should not be made use of simply for the convenience or benefit of a drainage area, particularly where the railway has not interfered with natural conditions to the extent of making drainage more difficult or expensive than it would otherwise have been. On the other hand there are circumstances in which natural conditions have been so altered that it is difficult to procure drainage in any other way than along the railway ditches and borrow pits, and under circumstances we see no objection to the location of award ditches or municipal drains along the railway lands. Section 250 of the Railway Act recognizes this principle and requires the railway company, independently of the drainage laws of the province, to "make and maintain suitable ditches and drains along each side of, and across and under the railway, to connect with ditches, drains, drainage works and watercourses upon the lands through which the railway runs, so as to afford sufficient outlet to drain and carry off the water, and so that the then natural, artificial or existing drainage of the said lands shall not be obstructed or impeded by the railway." In case of municipal drains being so located along the right of way, and bridges becoming necessary at farm crossings, these should be properly provided for under Sub-section 3 of Section 9 of the Drainage Act, the allowance or payment being to the railway company.

Cost to the Railways

Crossing a railway track with any drainage work is expensive in comparison with other portions of the work and should not be required under the award or report of an engineer without careful consideration. Since railway companies are required to pay practically the whole cost of these crossings, they are frequently asked for by owners who would see the railway company put to great expense for a crossing rather than spend a small sum to obtain drainage in some other way. Regardless of whose money is used to obtain the required result, the engineer should see that no expenditure is required unless some commensurate benefit will be derived. In the words of the Drainage Referee (Grand Trunk Railway and Canadian Pacific Railway vs. Rochester) "the underlying idea is that the construction of the railway has interfered with natural conditions and that the intention of the legislation is to permit the parties to revert to natural conditions as far as they can possibly do so, but of course, subject to proper limitations. In other words, the

railway should not be permitted to interfere with any work which is reasonably necessary to the proper cultivation of lands in the neighborhood, but if this is a sound proposition, the converse must be equally sound, and unless it is reasonably necessary for the proper cultivation of the lands in the neighborhood the municipal authorities should not be permitted to interfere with the railway. . . . The question of the cost of these culverts is of great importance. On the part of the Township there is, of course, a natural tendency to think that money spent by the Railway company is not to be considered, but I must and do treat the matter of expenditure by the railway company exactly the same way as I would treat expenditure of a farmer of limited means."

Some Illustrations

Let us illustrate from real life how unreasonable some requests are in regard to these railway crossings. An existing municipal drain runs west along the south side of a railway, crosses to the north side through a five-foot iron culvert, continues west along the north side about one hundred feet to a farm boundary, and then turns north along the boundary lines. When a survey was being made for the repair of the drain, the land owner asked to have the culvert moved to a point opposite the boundary, in order to do away with two rectangular turns, which he considered very objectionable. When it was pointed out to him that a better result could be accomplished at a cost of twenty-five dollars, instead of five hundred, by locating about two hundred feet of ditch in the depression across the corner of his field, he suddenly discovered that those rectangular turns were old friends of his, and he did not want them interfered with. In another instance a land owner planning a system of tile drainage wanted a main or outlet tile on one side of the railway, with several branches or laterals across the railway. These are, perhaps, extreme cases, but they show what the drainage engineer has to consider before these matters ever come to the attention of the railways.

Drainage works across railway lands should, as far as possible, accommodate themselves to existing openings under the tracks, both as to grade and dimensions. It is absurd for instance, to ask a railway to lower a pipe culvert three or four inches, to the arbitrary grade line established by the drainage engineer. The grade line should be made to fit the culvert unless a substantial deepening is required. As to the size and character of the opening, the existing structure, if there be one, should be first considered, and if it reasonably meets the requirements of the drainage work, the railway should not be obliged to incur a heavy expenditure for a trifling enlargement. Water will go through any opening, however small, if given sufficient time or sufficient head. The effect of a slight contraction in a ditch, due to a bridge or culvert opening being somewhat smaller than the sectional area of the ditch, is to raise the surface of the water a little higher on the upper side of the opening than on the lower, and the water goes through with a greater velocity. The flow through the bridge or culvert may also be accelerated by the decrease in friction of the walls, as compared with the banks of the ditch.

Reconstructed Culverts

There are many masonry and concrete culverts, which, while having sufficient width and sectional

area, are found to have insufficient depth for the improved drainage which is now general throughout the country. In such cases additional depth may be secured by using a pipe culvert in addition to the larger opening, or by the construction of a solid invert between the footings of the culvert, or in case of a solid invert already constructed but not of the proper depth, the central portion of this may be removed and reconstructed. In all cases of this kind the drainage engineer should consult with the engineering department of the railway.

When new openings are being provided for, the convenience and the standard practice of the railway should be considered. It is more convenient and less expensive for a railway company to construct bridges or culverts at right angles to the tracks than it is to construct them obliquely, and this should be borne in mind by the drainage engineer, particularly in the case of small openings. The diversion of a small ditch by slight curves at either end of the culvert is not so serious a matter as the opening up of a considerable section of road bed in order to put a pipe or box culvert obliquely under the tracks. For the larger ditches, such as are constructed by dredging, it may not be practicable to cross the tracks at right angles, and then skew bridges are a necessity.

What the Railways Should do

The railway company has "the option of constructing the portion of any drain or drainage work, required to be constructed upon, along, under or across its railway or lands," and from this apparently simple provision of the Railway Act some interesting questions arise. For instance under the Drainage Act, where assessment is made in money, can the company under this option choose to construct only a part of a drainage work upon its land, say the portion under the tracks, leaving the remainder to be done by the municipal council or its servants or contractors? Or is the option which the company has, to construct the whole of the work on the railway lands or none at all? Again, if the company constructs the whole of the work along and across the railway lands and the value of this work exceeds the assessment against the railway, as it sometimes does, is the difference to be paid over to the company as if to a contractor? Railway companies are not inclined to have their tracks opened up by drainage contractors, but prefer to have the work under the tracks done by their own men, and usually exercise their option in this way. Some cases have occurred, however, where the drainage engineer's estimate of the cost of crossing the railway was considerably below the cost for which the work could actually be done and in some of these cases the companies have chosen to pay the assessment and let the municipal authorities do the work under the tracks, with the result that the drainage area has had to bear a portion of the assessment which should properly be borne by the railway. The report of the drainage engineer should not set any temptation of this kind in the path of the railway officials. On the whole, it appears most convenient and reasonable that the engineer in his report should estimate separately the cost of the ordinary drainage work on the right of way, such as tile drain, team work, or dredging, and the cost of the work under the tracks, and that the railway should be allowed to construct either the crossing or the whole of the work on its lands, at its own option; but in no case should the railway be allowed

to perform the ordinary ditching and unload the bridge or culvert on the municipality.

The "increase of cost" of drainage work across or upon the railway due to the construction and operation of the railway, is to be borne by the company. We do not understand by this that the company should be assessed for this increase and nothing more, as has been contended by some railways, but rather that the company should bear this increase of cost under the express provision of the Railway Act as well as being liable to assessment for benefit, outlet, and injuring liability under the provisions of the drainage laws. The direct benefit to railways due to drainage is very important, and comparable to the benefit to highways. A specific case is where a track crossed the corners of a swamp, and required ballasting almost annually, but after the drainage of the swamp the road became quite firm, and no further trouble was experienced. Assessments against railway lands for outlet and injuring liability should be on the same basis as against lands and roads similarly liable.

Increase of Cost

There is some difference of opinion among engineers as to how the assessment under the Drainage Act is to be harmonized with the evident intention of the Railway Act in regard to this "increase of cost." The usual practice has been, as above suggested, for the drainage engineer to estimate the increase, and assess it specially against the railway, taking care that his estimate and assessment in this respect shall be sufficient for the purpose intended. This works no injustice, unless the amount so assessed is allowed to remain in the schedule of assessment for maintenance, in which case the railway might be liable for an undue proportion of the cost of maintaining the whole drainage work. An alternative plan, which would certainly accord with the spirit of the Railway Act, and possibly do no violence to the Drainage Act, would be to omit entirely from the formal estimate and schedule of assessment the cost of railway crossings, merely providing that the actual cost of such work, whether performed by the railway or the municipality should be borne by, or assessed against, the railway.

Under the Ditches and Watercourses Act, where the work itself is apportioned amongst the interested owners instead of an assessment being made in money, we take it for granted that the township engineer in making his award, would require the railway company to do any necessary work under the tracks and road bed, and that any further work necessary to make up the company's fair proportion of the whole work would be assigned to the company on the right of way; that the company would not be required to do any portions of the drainage work outside of the limits of the right of way unless such were absolutely necessary in order to make a fair apportionment of the whole work. If any considerable section of the ditch should be along the right of way it would probably be necessary to require private owners to perform a portion of this in order to distribute the burdens of construction in proportion to the benefit. Under these particular circumstances we would hardly expect the company to exercise the privilege of performing all the work on the right of way.

Obtaining Approval of Drainage Plans

No drainage works may be constructed or reconstructed, upon along, under or across railway lands, until the character of such works, or the specifications

of plans thereof, have been first submitted to and approved of by the Board of Railway Commissioners. When and by whom should application be made for this approval? The machinery provided for carrying out the provisions of the Ditches and Watercourses Act is very different from that provided under the Drainage Act and the proceedings are quite different. Under the Drainage Act the municipal council assumes the responsibility for constructing the work in accordance with plans and specifications provided by the engineer and incorporated into a by-law. As the council thus acts as trustees for the whole drainage area it is expected that the council through either its clerk or its solicitor, will take all necessary steps towards securing the approval of the Board. Under the Ditches and Watercourses Act the award of the engineer becomes effective as soon as it is filed with the clerk, or in the event of its being appealed against, as soon as it is confirmed by the County Judge or the Drainage Referee. The municipal council is not directly interested unless, as owner of the road or other property, it is required to construct a particular portion of the ditch. There appears to be no responsibility on any individual to apply for the approval of the Railway Board, still the award cannot be enforced until this approval is obtained. In order to make this situation clear to all the owners affected by the award, it is advisable that the award itself distinctly set forth that its provisions are not effective until the approval is secured. As the railway company has the same privilege as other owners of appealing to the County Judge and also if necessary to the Referee, not only against the apportionment of the work, but also against its character and location, it appears reasonable that if the company makes no such appeal it should not make any serious objection when the application comes before the Board. Though no person is responsible for making this application it usually devolves upon the individual who initiated the proceedings, or, by instructions of the municipal council, it may be undertaken by the clerk or solicitor. The estimated cost of the application may be provided for in the award and be part of the costs charged against the railway company. The company may then obtain the approval of the Board at little or no expense and in this event the cost should not be collected from the company, or if already collected, should be returned. For similar reasons it would appear that the proper time for seeking approval of work to be done under the Drainage Act should be after the lapse of the time in which the company has the right of appeal to the Drainage Referee, or after the disposal of such appeal, if any. If the drainage work on the railway lands is not permitted by the Referee, the report of the engineer or the provisional by-law of the municipality is set aside and no further proceedings are necessary, as in the comparatively recent case of the Canadian Pacific and Grand Trunk Railways against the Township of Rochester, to which previous reference has been made.

What the Railway Board Deals With

As to the particulars which might be dealt with by the Railway Board there was at first considerable confusion and misunderstanding, which was cleared up to a great extent by an order of the Board dated January 17th, 1910, which reads in part as follows:

"The practice in the past has been to submit to the Board, along with the material, the Engineer's report, and a plan of the whole drainage area, with the names of all the land owners affected by the proposed work, etc. In some

instances, the actual bridge or culvert plans, so far as the work affects the railway, have not been submitted.

"It would seem that the proper view of this legislation is that the Railway Board has nothing whatever to do with the general drainage scheme, with the apportionment or distribution of cost of the work, or the fairness or legality of the proceedings, or the validity of the by-law. The legislature has provided forums for the adjustment of all these matters, and the Railway Board is called in merely for the purpose of seeing that the structure that is proposed for the drainage work is of a character that will not interfere with the safe operation of the railway.

"In future, upon application of this sort, all that need be filed, or submitted to the Board for approval, will be the estimate of the engineer of the volume of water that will probably pass through the culvert or opening through the railway lands and the size he thinks the opening should be. This should be in the form of a statutory declaration, and the proposed mode of carrying the railway over the opening or culvert, with all proper plans of the work, should accompany the application.

Company Designs Culverts

Plans and specifications of railway culverts and bridges prepared by drainage engineers were usually unsatisfactory to the railway companies, who preferred to follow their own standards of construction, and the order above quoted has been modified to the extent that drainage engineers are now required only to specify the volume of water to be provided for and the dimensions of the waterway required, leaving the detailed plans to be supplied by the company.

The limit of the cost of work which may be undertaken under the Ditches and Watercourses Act is fixed by the Act at fifteen hundred dollars, and if this amount must include the cost of crossing a railway with a new bridge or culvert it would be almost prohibitive. There is a possibility however, that this section of the Act may be interpreted to apply only to the cost of work exclusive of the cost of crossing a railway, the railway crossing being more in the nature of an incidental or extra than an ordinary portion of a drainage work. We had occasion, however, to consider a requisition under the Ditches and Watercourses Act in which the crossing was looked upon by the applicant as the entire work and was the only thing asked for, the apparent intention being to apply compulsion to the railway and reserve individual liberty for the land owner. The requisition was refused and no action taken on it, on the ground that every ditch undertaken under the Act must be continued to a sufficient outlet, that a railway crossing was only incidental to the construction of a complete drain, and that the railway was as much entitled to have an outlet provided under the award as the applicant to have his crossing.

Railway Companies Same as Land Owners

While our drainage laws impose the same burdens on railway companies as on other land owners, they also give these companies the same privileges, and in cases where it becomes necessary to secure outlets for the drainage of railway lands, the companies have as much right to initiate proceedings either by requisition or petition as any other owners. They are entitled to the same treatment without fear, favour or prejudice, by the engineer and by the municipal court of revision, and neither the railway's ability to pay, nor the improbability of their appealing against assessments, affords any reason for discrimination against them.

Loss of Head in Sewage Sludge Pipe at Toronto, Ont.

OWING to the necessity of obtaining some data as to the loss of head due to pumping sludge through pipes, an experiment was made at the main sewage-disposal works, Toronto, on the 12-in. cast-iron sludge discharge main. The data were required for use in a report on sewage disposal. An article embodying this information has been published by T. H. Nevitt, superintendent of Sewage Works, Toronto, in Engineering News Record, a review of which follows:

The sludge experimented with was obtained from the sedimentation tanks, and was not more than ten days old. This sludge was released from a tank through four 8-in. valves situated at the apex of the bottom hoppers, and flowed through a 10-in. cast-iron pipe, on a 2 per cent. grade, to a sludge well in the

OBSERVATIONS ON FLOW OF SEWAGE SLUDGE THROUGH 12-INCH CAST-IRON PIPE AT TORONTO

Head in Pipe									
Loss of Inches of Mercury	Feet of Water	Feet of Water per 100 Ft. of Pipe	Discharge, Cu. Ft. per Sec.	Area of Pipe, Sq. Ft.	Velocity in Pipe, Ft. per Sec.	R	S	C	Hazen & Williams' Formula, C for Observed Loss of Head
3 1/4	3.41	1.415	5.00	0.785	6.36	0.25	0.0141	108	0.017
3 1/4	3.15	1.306	4.92	.....	6.26	.....	0.0131	110	0.017
3 1/4	3.41	1.415	4.90	.....	6.24	.....	0.0141	106	0.017
3 1/4	3.41	1.415	4.88	.....	6.21	.....	0.0141	105	0.018
3 1/4	2.89	1.199	4.81	.....	6.12	.....	0.0121	111	0.017
3 1/4	3.15	1.306	4.79	.....	6.10	.....	0.0131	107	0.017
3 1/4	3.41	1.415	4.77	.....	6.10	.....	0.0141	103	0.018
3 1/4	3.15	1.306	4.72	.....	6.07	.....	0.0131	104	0.018
3 1/4	2.89	1.199	4.70	.....	5.98	.....	0.0120	109	0.017
3 1/4	3.41	1.415	4.69	.....	5.97	.....	0.0141	101	0.018
3 1/4	3.15	1.306	4.67	.....	5.94	.....	0.0131	104	0.018
3 1/4	3.15	1.306	4.65	.....	5.92	.....	0.0131	104	0.018
3 1/4	3.15	1.306	4.62	.....	5.88	.....	0.0131	103	0.018
2 3/4	2.89	1.199	4.55	.....	5.79	.....	0.0120	105	0.018
2 3/4	3.02	1.253	4.50	.....	5.73	.....	0.0125	102	0.018

pumping station. Here it flowed into an 8-in. centrifugal pump and was raised about 35 ft. and discharged through 400 ft. of 12-in. cast-iron pipe and some 200 ft. of 10-in. spiral-riveted pipe to the sludge lagoon.

After leaving the pumping station, the pipe is supported on posts at a distance from 10 to 6 ft. above the ground, and turns down just below surface level in the lagoon, where it discharges. The pipe was laid some five years ago, on a grade of 1 in 80, which it still retains, although, through the action of frost on the supporting posts, the alignment is not so good. Pump tests show that this grade is sufficient to carry the sludge away by gravity.

As the pipe ordinarily does not flow full, it was necessary to cause it to do so, and this was done by making a siphon at the discharge end, the height of which was a little greater than the loss of elevation due to the grade of the pipe.

For the purpose of the experiment, a length of 12-in. pipe south of the station was selected which was unaffected by either valves or bends. In fact, no obstruction to the flow occurred within 12 ft. of either end of this test length, which was 240.5 ft. long.

Measurement of Loss of Head

To measure the loss of head, two 3/4-in. holes were drilled through the cast-iron pipe on its horizontal diameter one at each end of the section selected, and,

to insure the entrance being square and sharp, these holes were cut with a sharp drill running at high speed. The pipe was then counterbored half way through its wall and tapped to take a 3/4-in. water pipe. At the north end, the 3/4-in. pipe was turned down and then run horizontally to a point 6 in. north of the middle of the test length, while at the south end the pipe turned north and ran horizontally to 6 in. south of the middle. At this point, a mercury U-tube was inserted and connected to the 3/4-in. pipe by rubber tubing. Quarter-inch gate valves controlled the pipe at the north and south ends and 3/4-in. pet-cocks at the center. The scales on the U-tube could be read to 1/8 in. and estimated to 1-16 inch.

The volume of sludge was measured by a 12 x 6-in. venturi meter and register indicator recorder of the latest type. The indicator has a uniformly divided scale which can be read very accurately.

Before the experiment was started, the 3/4-in. piping was carefully filled with clean water and all air was expelled; the watches of the two observers and the recorder clock were regulated as to time. Readings were taken at 5-min. intervals. At the end of an hour the observers changed places, and the experiments were continued for another hour. Some difficulty was experienced in reading the U-tube on account of the continual fluctuation of the mercury column, but the reading at the 5-min. intervals was that recorded. The fluctuation was fairly uniform until a discharge of 4 1/2 sec.-ft. was reached, below which it became very erratic. In consequence, these results were neglected. This was for two reasons: (1) On account of the small differential an error of 1/8 in. in the reading made a large percentage error, and (2) the flow had become turbulent due to choking in the sludge pump from heavy sludge and also the low discharge.

Experimental and Calculated Results Closely Coincide

The value of *n* was determined by substituting in Kutter's formula for *C* and solving for *n* in each case. The results show a variation from 0.0168 to 0.0181, which is probably accounted for by variations in the density of the sludge. For comparison, the value of *C* in Hazen and Williams' formula was worked out on the slide rule. The results show that for Toronto conditions the addition of two years to the age of the pipe permits the Hazen and Williams' tables for water to be applied very closely.

Pint samples of sludge were taken every 10 min. at the discharge end of the pipe, and collected in a pail. At the end of the experiment, these were stirred thoroughly and a sample was taken for analysis.

The sludge analyzed as follows: Specific gravity, 1.01; moisture, 95.9%; solids, 4.1; percentage of dry solids which are volatile, 50.5; ash, 49.5%. The temperature of the sludge was 54 deg. Fahrenheit.

The experiment was carried out under the general supervision of R. C. Harris, commissioner of works for the City of Toronto, G. G. Powell, deputy city engineer, and W. R. Worthington, assistant engineer in charge of sewers, and under the writer's immediate direction.

At the opening session of the Ontario Good Roads Association, in Toronto, last week, Hon. Finlay G. Macdormid, Minister of Public Works for the Province, stated that the Dominion Government's financial assistance to the Provinces for 'Good Roads,' was to total \$20,000,000, to be divided among the provinces on a basis of population.

Why the Commission-Manager Form Is Preferable to Commission Government

By Mr. R. E. Bosshard*

UNDER the commission plan each commissioner was clothed with responsibility of the charge of a department. Since he was elected at large, the welfare of the entire community came within his official sphere. No single section was favored to the detriment of the others and the public felt that a greater measure of responsibility to it had come to pass.

As the commissioners are well paid for their services, they give more attention to their duties. What was once everybody's business has at least become somebody's business and closer attention to details has caused the elimination of much red tape, the fixing of standards of efficiency, reduction in rates in some instances of public owned utilities and in general, better results from the various departments with corresponding general improvement in the city's appearance.

In the light of these facts there is no gainsaying that this new type of municipal law has produced benefits. Its coming and life thus far have created a new civic consciousness rarely before experienced. While there have been a few instances of seeming failure and this is within the law of average, for in all efforts there are a few failures, yet there is no record of such corruption and waste as have characterized the cities governed under the old type. Nevertheless, there are some serious drawbacks to this form. The last word in municipal management had not as yet been written. Its success primarily is due to the fact that "new brooms sweep clean." The novelty of it has brought closer attention just as a new toy replaces the older playthings. Of itself this new form has produced some incentive for officials to succeed. But inherently it does not offer something definite and final. What, then, are its defects?

One is the election of men to positions requiring administrative and executive ability. Any man, no matter what his previous situation in life may be, is eligible to seek the office. His qualifications are scarcely sought. If he can interest the public sufficiently in his cause, whether through treating, cajoling, or honest efforts, he stands a good chance of election. In no sphere of human activity but in this could a barber become a commissioner of water, a house-mover a commissioner of public buildings, a carpet dealer a commissioner of public works, a dentist a commissioner of health and safety or an architect a commissioner of streets. Would any one of those business men in his civilian office have taken a man who had trained himself for a commissioner as a barber, a house-mover, a carpet salesman, a dentist or an architect? "Ridiculous!" he would say, "I want a man who has had experience if he is to be paid." By the same token cities should not receive men who have had no training for their work and pay them handsome salaries.

Though the vast majority of commissioners have had no training in private life to fill their respective positions, many of them have latent potentialities, which in their new position offer opportunity for development and fruition. But unfortunately, in many instances where a man has been elected and held the

office for a period of four years and has served his "apprenticeship," election time comes along and he loses. Then a new one comes in. He makes as many changes in the personnel of his department as he can. The public business suffers again—in fact, receives a setback—while another commissioner serves his "apprenticeship," and so on, ad finitum. The first holder of the office perhaps lost it because of some action taken by him in his capacity as a member of the legislative body, and herein is a serious defect in this form of organic law. The commissioners are at one and the same time a law and policy making body and heads of departments. These two functions of government should be kept entirely separate. Greater permanency to the department executive with corresponding proficiency can thereby be gained. It gives the individual a greater sense of security in his position and does not require his "playing to galleries" to retain it. That is, provided, of course, he be appointed and not elected. Let the policy determining body come from the people direct through election, for they must reflect the will of their constituents. Let them determine what is needed, what is best, and then turn to the departments to carry their affairs, by a board of directors, who appoint at a commensurate salary, a general manager who understands the business. No board would for a moment trust the responsibility of its corporation into the hands of some stockholder who is looked upon as a "hale fellow well met," and whose chief ability is to draw votes. Instead, a competent man is selected and if he gives adequate service he remains. If he does not, someone who can is then selected.

This is the principle of the city managers form of government as now adopted by some hundred cities in the United States. The "principle" of it is absolutely sound. It is indeed an instrument of efficiency which gives public officials a chance to produce the most far-reaching achievements. Where the commission form fails in constituting a method, this type fulfills practically every condition required to be a method. A charter of this kind properly drawn combines all the safeguards that a democracy demands and gives ample leeway to the official to produce the best possible results. The "principle" of it, let it be repeated, is sound.

Obviously for the best possible achievement in any endeavor as well as municipal government there must be complete synchronizing of authority and responsibility. In this particular and important feature the commission form breaks down. Each commissioner has full responsibility, but unfortunately insufficient authority. The commissioner of streets, for example, is charged with the proper construction of sidewalks. The commissioners antagonistic to him, in a desire to reduce expenses, vote to eliminate the office of inspector. The commissioner of streets realizes that an inspector is necessary to watch the contractor, but he cannot employ a man because no power to do so is vested in him, for no provision is made in the civil service rule. The result is obvious.

The legislative body of a city should be composed of not less than five members and rarely, except for

*From a paper before convention of League of Pacific Municipalities.

very large cities, of seven. This makes for the short ballot, lessens the likelihood of bitter factional quarrels and renders less cumbersome the procedure of business. The function of this body should be purely legislative and policy making. Each member of it should represent the entire city; this fact requiring the elimination of ward lines. Features tending to sectionalize the city should be avoided.

The Council should appoint the City Manager for an indefinite term of office. Nor should there be any limitation as to prior residence. He should be safeguarded in his position so that at least a four-fifths' or five-sevenths' vote would be required to remove him. Under him all departments should be placed. These to include the assessor, treasurer, health, fire, police, park, recreation, street, city engineer, purchasing agent, charities, municipally owned public utilities and such other administrative departments as are locally peculiar. Consolidation of departments in the discretion of the Manager should be permissible. The City Manager should recommend to the Council the salaries to be paid, but that body should have the final word in determining both the amount of and the actual fixing of the same. To leave the matter entirely in the hands of the City Manager is repugnant to the principle established by our forefathers. The spending power of a municipality should lie in the hands of the Council, because that body is directly representative of the people and of those who support the government.

In municipal charters there should be a provision requiring candidates to give to the people a statement of their qualifications for the office which they are seeking.

Eliminate Restrictions

Let there be no civil service restrictions whatsoever. This may seem somewhat unusual, for so it is indeed. The civil features that we have today in municipal charters have their outcome as result of the adoption of our federal government. In times past we have copied the federal law extensively. There is an historical reason for this. We have looked upon the city as a small republic or a small state and have viewed it in the same light as did educators of two and three centuries ago, who considered a child but a small being endowed with the same mind of an adult. We have learned, however, that there is a vast difference between the mind of a child and the mind of an adult; that there is a difference in quality as well as in quantity, so that education of today is based upon entirely different methods to those employed in dealing with the adult mind. Similarly conditions in a municipality differ in quality with those of the national government, and we must view them from a different standpoint altogether. Because the national government found it necessary to adopt the civil service to protect its employees, does not follow that a city government under a City Manager should need the same protection. A City Manager holds his position not because of political reasons, but because of his inherent ability to do the work. He has no axes to grind nor enemies to punish. He is seeking efficiency, and those in the city's employ who have given efficiency are just as likely to hold their positions as are employees in any private corporation.

It is a well known fact that a man may pass an examination successfully and yet be an unsatisfactory individual in applying in a practical way what he can put

on paper. Under the civil service such a man can be appointed and once in it is very difficult to remove him. A City Manager should have a free hand both in the employment and the discharge of employees. He should be able when necessity demands to remove them from one department to another, without being hedged by fixed rules. Probation periods do not disclose all the defects of an individual and hence any limitation which will tie a City Manager's hands simply makes his work more difficult.

There has been a tendency to create boards to carry on municipal work. We have had Boards of Health, Charities and Correction, Liquidation and Library Trustees, Theatrical Censors and the like. Save for possibly the Board of Education, which has been recognized by state law in some states as an entirely separate unit, no positive need for these bodies exists under a city manager form of government. At best they too often prove sources of dissension and quarrel and help to pile up the red tape and irresponsibility that exist in municipal administrations. The city manager charters permit the Manager to appoint advisory groups to assist him in any problem that he may deem necessary. They work with him and not against him. His responsibility is not shifted, since they are but advisory and have no authority whatever delegated to them. Thus elimination of these boards gives greater centralization and a better opportunity for the despatch of business.

Existence Justified

This new form of government is by no means a panacea of all municipal ills. It is founded upon the structure of human participation and interpretation, and we know that mortals are not endowed with infallibility. It has been attacked in the courts and there have been managers who failed. The fact that its bitterest opponents are principally the old line politicians is ample justification for its existence, and finally, as the progress made through the commission form of government renders null and void the stigma of James Bryce's comment, so this new type, because of its fundamental principles and the application thereof, renders Henry Bruere's statement no longer forceful.

Officers for 1919

At the meeting of the Ontario Good Roads Association the report of the nominating committee, which was accepted unanimously, recommended the following officers for 1919: Honorary presidents, J. A. Sanderson, Oxford Station; S. L. Squires, Waterford; C. R. Wheelock, Orangeville; president, K. W. McKay, St. Thomas; vice-presidents, J. J. Parsons, Jarvis; W. H. Pugsley, Richmond Hill; Capt. L. E. Allen, Belleville; secretary-treasurer Hon. Geo. S. Henry, M.P.P.; assistant secretary-treasurer, Major T. L. Kennedy, Dixie; directors, F. A. Senecal, T. J. Mahoney, W. H. Brown, Cyrus Edgar, John Curry, Mr. Jamieson.

A. C. B. & C. I. Committee Meets

The Eastern members of the National Council of the Association of Canadian Building and Construction Industries held an executive meeting in Toronto on March 5 and 6, at which tentative by-laws were drawn up and various items of business discussed. The decisions reached are to be submitted for the approval of the Western members, who will hold a meeting in the West for this purpose shortly.

Trade Publications

Pointing, thread-cutting and special tapping machinery—illustrated catalogue by Webster & Perks Tool Co., Springfield, Ohio.

Rustproofing Process—catalogue issued by the Parker Rust-Proof Company of America, Detroit, describing, with illustrations, the Parker process of rust-proofing iron and steel, which consists in the changing of the chemical composition of the surface so that chemical action does not occur.

Air Compressors; Steam Stop Valves, Check Valves, Water Valves and Accessories—Two very complete catalogues, issued by Alley & MacLennan, engineers, Glasgow. These catalogues are well illustrated, bound with stiff covers, and contain a quantity of useful information on the subjects of which they treat.

Mainly Constructional

East and West—From Coast to Coast

Mr. W. Mortensen, B.Sc., has opened an office at the New Birks Building, Montreal, as consulting engineer.

Baldry, Yerburg & Hutchinson have re-opened work on one stretch of the Welland Ship Canal and have about 200 men employed.

The city council of Galt, Ont., is having a by-law prepared to enable the city to take advantage of the government's housing scheme.

The citizens of Selkirk, Man., are again agitating for the erection of a bridge over the Red River at that point by the Federal Government.

In one day last week there were building permits issued in the city of Toronto to the value of \$50,000. The demand seems to be mostly for stores and dwellings.

Montreal building permits for February totalled \$151,740, a gain of \$74,695, while for the two months of the current year the value was \$211,894, an increase of \$18,739.

A deputation from Willow Bunch, which recently visited Toronto, was promised an extension of the C.N.R. Bengough line forty miles west from their locality.

The Chatham water commission has completed a deal with the Imperial Munitions Board for the purchase of a liquid chlorinator for use at the local pumping station.

A campaign has been opened to raise \$500,000 for the completion of the Loyola College buildings at Notre Dame de Grace, P.Q., operations on which were interrupted by the war.

A bill is to be introduced at the current session of the Nova Scotia Legislature to provide for the expenditure of the moneys placed at the disposal of the Province by the Dominion Government for housing purposes.

The question of installing a sewage disposal plant is pending in Peterboro, Ont., and it is stated that work is to be commenced on it as soon as the board of works has disposed of the Hunter Street bridge matter.

The Ottawa city council have decided to secure the services of a competent architect or practical builder, who will have charge, generally, of the erection of new buildings, the care of existing ones and building inspection.

Figures contained in the first report of the Workmen's Compensation Act Commission of Alberta, show that the cost of labor for producing a ton of coal from the mines of that province is \$2.65.

The construction of the road from Hope to Princeton will cost about \$307,000, according to a recent statement of

Hon. Dr. King, Minister of Public Works for British Columbia. The survey is 92.8 miles in length, with a maximum gradient of 8 per cent. for 3 miles.

A scenic route from Toronto via Whitby and Port Perry through the Kawartha Lakes, Muskoka and Algonquin Park, returning by the west shore of Lake Simcoe, has been proposed by the Lindsay municipal authorities and is receiving support from other municipalities.

The building permits issued in Chatham, Ont., during the month of February are valued at \$8,100, an increase of \$5,225 over the same month last year. The total for the two months of this year is \$11,990, as against \$3,085 in the same period of 1918.

Amendments to the Highway Act are being submitted at the present session of the Nova Scotia Legislature, for the purpose of making further provision for carrying on road work and co-operating with the Federal Government in its proposed aid for highway improvement.

Seattle interests have declared their intention of building a floating dry-dock, of 25,000 tons capacity, together with a shipbuilding and repair plant, to cost in the neighborhood of \$4,000,000, provided they can obtain the subsidy granted under the Dry-dock Subsidy Act, and other privileges.

The building permits issued in Welland, Ont., during the month of February this year reach a value of \$14,150, as compared with \$5,200 for the same month last year. The total for January and February is \$29,405, as against \$25,610 for the same period in 1918.

The Soldiers' Housing Commission at a recent meeting in Vancouver reached the conclusion that at least 200 new houses are at present required in the city for returned soldiers and their families, in order to afford any satisfactory solution of the housing problem.

An Order-in-Council has been passed authorizing the publication of two volumes of descriptive matter relating to the design, construction and tests on the Quebec bridge work. The report will be sold at \$5.00 per set of two volumes, no free distribution being made. The volume will be of particular interest to the engineering and contracting profession.

A Provincial Builders' Exchange has been formed for the Province of Saskatchewan. Delegates from the various exchanges in the province recently met in Regina and initiated the organization, Mr. Wm. Wilson, of Regina, being elected president, and Mr. Shannon, of Saskatoon, secretary, with three representatives each from Saskatoon, Moose Jaw and Regina, on the executive of nine.

The Temiskaming & Northern Ontario Railway will push their Porcupine branch through to the Mattagami River and will construct docks and storehouses at that point, according to a recent report. A steel bridge is being built over the river at Mattagami heights, which will provide through traffic from Timmins to the townships of Mount Joy and the country beyond.

A deputation representing the municipalities of Shellmouth and Shell River, Man., recently waited on D. C. Coleman, vice-president of the C. P. R., to urge the extension of the company's lines in a northerly direction from Russell, Man., to serve territory which they claim is now in need of railway facilities. A promise was made that the company would investigate and make a survey.

As a result of a recent conference between representatives of the city of Winnipeg and the Manitoba Architects' Association, a committee of five members of the association was appointed to submit plans, specifications and estimates of cost to the city on a housing scheme. Mr. R. B. Pratt, president of the Association, is on the committee. The ter-

race style of dwelling, detached and semi-detached houses will be covered.

It has been decided to send a survey and exploration party to survey the route of the proposed extension of the Temiskaming and Northern Ontario Railway to James Bay. Previous to the war a preliminary survey was made, but it is desired to obtain more information before undertaking the heavy expenditure which would be necessary in constructing a line from Cochrane to the Bay. A comprehensive exploration of the whole area is to be made. Its resources will be investigated and the possibilities of power development at Abitibi Canon examined.

The engineers' report upon the reclamation of the Sumas Lake area have been received by the British Columbia Government and are said to be more favorable than was anticipated, with the result that this big scheme may be undertaken this year. The Sumas section coming under the proposed reclamation covers approximately 30,000 acres, most of it under flood every spring, and to dyke and reclaim it would require an expenditure of more than a million dollars. About 12,000 acres is owned by the Dominion and the balance by private owners.

Regarding the amalgamation proposed by the Greater Vancouver Sewerage Board, City Engineer Stewardson, of New Westminster, has reported to the council that it does not appear that it would be to the advantage of the city to enter the scheme. Under the Board's proposal, it is stated, the city would be assessed too highly in proportion to other areas for the cost. Another objection is that the work of making house connections, laterals, etc., is so closely interwoven with other civic work that it would probably not be so economical to have this work in the hands of the Joint Sewerage Board.

Plans for harbor development at Hamilton, Ont., submitted to the local harbor commission by James Wilson, government engineer, have been endorsed. The immediate reclamation of 50 acres of submerged land is provided for, and it is also proposed to continue this work from year to year until an additional 150 acres have been reclaimed for park and factory purposes. Members of the commission are to present their claims to the government regarding this project, and they will ask for an increase in the government appropriation of \$250,000. It is now estimated that this work will cost about \$325,000.

The Canadian Ingersoll-Rand Company, Limited, has recently absorbed the Jenckes Machine Company, Limited, of Sherbrooke, Que., thus putting them in possession of two plants, the "Rand plant," and the "Jenckes plant." The products of the "Jenckes plant" will continue to be those familiar to customers of the Jenckes Machine Company, manufactured to the latest designs. Briefly, these are:—Ships' winch en, gines; structural and plate work; tanks, penstocks, etc.; mining machinery and equipment; ore crushers, cars, cages, etc.; and pulp and paper equipment, such as barkers, grinders, water wheels, etc. The headquarters of the Canadian Ingersoll-Rand Company are at 260 St. James St., Montreal.

A deputation representing North Bay and other Northern Ontario municipalities and boards of trade recently waited upon the Dominion Government to urge the feasibility and desirability of canalizing the French River between Georgian Bay and Lake Nipissing. It was stated that to secure a 50-mile stretch of navigable water, there would be required only three-quarters of a mile of actual canal with three locks, and Mr. J. B. McDougall, representing the North Bay Board of Trade, claimed that while the cost of the proposed canalization would be about \$16,000,000, or interest charges of \$720,000 at 4½ per cent., these interest charges would be more than met by an estimated revenue of \$750,000 per annum from

water power. Hon. F. B. Carvell, replying on behalf of the government, said he recognized the importance of the project and promised it would be given most careful consideration by the Cabinet as a whole. This scheme, if undertaken, would provide a link in a route from the northwest through Lake Nipissing to North Bay, which has already railroad connection with three transcontinental lines.

It is reported from Quebec that the provincial government will appoint a commission to carry out the provisions of the new housing scheme for Montreal. The members are to be representatives of various public bodies, particularly those who are interested in industrial housing questions. This did not meet the views of certain aldermen, who are stated to have been bringing pressure on the government to appoint aldermen, on the ground that direct representation of the people is desirable. The government, however, it is understood, are not willing to play the game of local politicians. An effort is being made to secure united action on the part of the many associations who are directly or indirectly interested in the housing question.

RECENT INCORPORATIONS

Montreal Forge & Shackle Co., Ltd., head office Montreal, capital \$20,000.

The Norton Tool & Machine Co., Ltd., head office, Toronto, capital \$50,000.

National Electric-Products, Limited, head office Toronto, capital stock, \$1,000,000.

The Eureka Molybdenite Corporation, Limited, head office Toronto, capital stock \$1,000,000.

P. J. Dwyer Molybdenite, Limited, head office, Toronto, capital stock \$350,000, to undertake prospecting, mining, etc.

R. Percy Sims, Limited, head office Montreal, capital \$20,000, to acquire consulting engineering practice of R. Percy Sims.

The Edmundston Development Company, Limited, head office at Edmundston, N.B., capital stock \$49,000. Among other activities, this firm is authorized to construct private and public works.

Aspromet Company of Canada, Ltd., head office at Sarnia, Ont., capital stock \$200,000, to carry on the business of manufacturers and dealers in steel, iron metal, asphaltum, asbestos, cement, etc.

Edward A. Robinson Company, Limited, head office at Montreal, capital \$50,000, to carry on the business of mechanical engineers and dealers in and manufactures of plants, engines and other machinery, etc.

Preston & Schwartz, Limited, is a firm newly incorporated for the purpose of manufacturing and dealing in taps, dies, tools, etc. Its authorized capital is \$40,000, and its headquarters will be located at Galt.

Personals

Lieut. Ernest O. Ewing, B.A.Sc., has returned from overseas and has resumed his position with the firm of James, Loudon & Hertzberg, Limited, Toronto.

Mr. Charles W. Dill, of Winnipeg, and formerly of Toronto, has been appointed to the position of superintendent of highways of the provincial government, with charge of all the field staff.

Major W. D. Adams, M.C., Assistant Engineer of Railways for the city of Toronto, has returned from overseas with an English bride. Major Adams joined the 14th Battalion (First Contingent), and has a very creditable record on the field.

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The Quantity Surveyor Deserves Consideration

ON another page of this issue, we print a letter received from Mr. Edward H. Beck, in which he puts forth strong arguments in favor of the general employment of the quantity surveyor for the purpose of cost estimating. There seems to be a very definite field for this branch of the engineering profession in Canada; in England it has been established with results which are, apparently, very satisfactory, and why there has been no effort to try its merits in this country is to be wondered at.

When the quantity surveyor is employed, as Mr. Beck points out, the contractor merely uses the plans and specifications as a means of determining the character of the work, but in the actual figuring of costs he depends upon the bill of quantities supplied by the surveyor. In this way, evidently, a great deal of wasteful duplication is avoided. One man is paid for doing work once, which, under the present system, has to be done by every firm figuring on a job. For this duplication the public has to pay, since the contractor must make allowances for the added expense in his overhead, and charge accordingly for his work, else he will inevitably drift towards bankruptcy.

Also, it would appear that by the employment of the quantity surveyor, a great many occasions of disagreement as to extras, unforeseen contingencies, etc., would be removed. Blanket clauses in the specifications would be rendered ineffectual. Any item of work arising during the progress of construction, for which provision was not made in the bill of quantities, would be an extra for which the contractor would have a definite claim to added remuneration.

On the face of it, the proposition appears to be sound, and the only defects which might arise in this system would, we believe, be those due to inefficiency on the part of the surveyor. And here indeed is another argument in its favor—that the quantity surveyor, being a man trained specially for this one branch of the engineering profession, is less liable to technical mistakes or errors of judgment, than the man whose capacity for the work is the result of only general training and experience.

In the cost-plus system of contracting, where bids are not called and the contractor is paid the cost of all the work he does, plus a percentage of profit, there would, from his viewpoint, be little necessity for the quantity surveyor, except as a member of his own staff, but, from the owner's viewpoint, the surveyor would undoubtedly provide a means of keeping a definite check upon the efficiency and honesty of the contractor. And where open tenders are called, or where bids are asked from a limited number of contracting firms, the advantage to both parties of employing a quantity surveyor, seems evident.

We are, therefore, heartily in accord with Mr. Beck's suggestion that a committee of contractors be appointed to investigate the merits of the quantity surveying system, and strongly recommend our readers to consider the question in the light of the arguments put forth in his article.

Let Our Memorials Be Useful Ones

THE suggestion has been made that one of the most suitable memorials that could be erected in honor of our Canadian soldiers who have fallen in action or died of wounds, would be the erection of necessary highway bridges bearing suitably engraved bronze tablets. How much more sensible this would be, to spend money on a most necessary public improvement of this kind, instead of erecting hundreds of unsightly and absolutely useless stone columns in local parks or public squares that are already cluttered up with useless memorials of this kind.

The public is always ready to contribute generously to any fund launched in the interests of our soldiers, and while little, if any, objection would be raised by any contributor to the memorial taking the customary form of a marble or granite monument, yet we feel satisfied that a more useful and impressive way of honoring the memory of our dead heroes would meet with an instantaneous and an exceedingly warm welcome on all sides.

A bridge or a building can be made as attractive architecturally as a mass of carved stone in the form of a monument could be, and it would certainly be a constant reminder to us of the sacrifices made by our men in the world war. In fact, serving as it would a most useful purpose in the every day life of the public, it would be difficult to imagine a more constant and effective memorial.

Contribution to Organization Fund Required

THE executive committee of the Association of Canadian Building and Construction Industries has ready for distribution a complete stenographic report of the Ottawa Conference, where the Permanent Canadian Association was launched.

There will probably be two classes of membership accepted—indirect and direct. All members of any district of local body would automatically be indirect members of the Canadian body, while any firm in good standing could, by paying the special fee designated to the National or Canadian Association, become a direct member of that body.

It is suggested that all local Exchanges or Builders' Associations be reorganized and form district branches. This has already been carried out in Montreal, Toronto, and Sherbrooke, with more to follow. The Montreal Builders' Exchange is now made over into the Association of "Montreal" Building and Construction Industries, with three distinct sections. By thus using the same name as the parent body, but substituting the name of the district centre for "Canadian" the affiliation is obvious to all.

They also hope to adopt soon a copyrighted Association stamp which can be used on letterheads, one for local branch organizations and a smaller one for the individual business letterheads of members.

The National Council of this new organization met in Toronto on the 5th and 6th of March, to approve the tentative constitutions and by-laws, etc., but decided they should not make any levy on local bodies until another convention of all Canadian builders is held, and the details submitted for definite acceptance.

It is the intention of the Association to employ a General Secretary, but before doing so it will be necessary to have sufficient funds available to meet their immediate needs. Mr. J. P. Anglin, President of the association, is asking for an immediate voluntary "boost" contribution from every contractor or supply man in Canada. He requests sums ranging from \$10.00 to \$100.00 and an immediate response will greatly facilitate the work of organization.

Send in your contribution immediately to the Hon. Treasurer, Geo. A. Grain, Ottawa. (Be sure and give him firm name and special business.) Send in suggestions, whether for the good of the members in particular, or the fraternity in general, to Mr. Dancy, 1112 C.P.R. Building, Toronto.

Necessity of Establishing Government Laboratory

THE government assurance that the long delayed extensions to the University of Toronto will forthwith be carried out offers a splendid opening for the establishment of what Canada has long been in need—a government-supervised testing laboratory for the collection of suitable and useful statistics about Canadian structural materials. Disjointed efforts and unorganized facilities have hitherto served to gather the very meagre information that is available at the present time. And these data are meagre; their extent does not go, in general, beyond the few experiments performed in college laboratories for demonstration purposes, or the occasional efforts of private parties to produce an advertising stimulus by the testing of some particular trade product. Attention concentrated on the collection of

complete data is certainly lacking, because the government has apparently become either too uninterested in the promotion of our own materials or disinclined to establish facilities for making investigations into resources of this nature.

Canadian conditions are not universal, nor are Canadian products—here, speaking specifically of building and structural materials.

We have our own peculiar varieties of brick, stone, cement, timber, but notwithstanding this, we have very little specific information that will lead anyone interested to gauge their structural possibilities. Canadian engineers have hitherto been obliged to seek fields afar for reliable figures concerning strength. The published bulletins of several well-established bureaus in the United States have been the only source of verified information, but these rarely take into account purely Canadian materials or purely Canadian conditions. To cover this field adequately, a Canadian testing station or bureau of standards must be established to take cognizance of our own peculiarities. Canadians should not be obliged to use foreign information about our own resources or, in the event of even this being lacking, to employ such information about foreign products.

Reconstruction proceedings emphasize the need of such an institution. We can expect greater efficiency from our efforts in the re-establishment of normal conditions of building and construction if we have at our finger tips a knowledge of our structural materials. The Government has, we believe, been aware of the situation and has hinted at the establishment of a bureau to meet our requirements. The universities have been mentioned as a possible location for such a station. To us Ottawa seems the logical point, but perhaps the government feels that the collection of statistics should begin before suitable facilities can be arranged at Parliament Hill. In that event, let us have the engineering faculties provided with the necessary equipment. The suggestion conveyed in the first sentence is indicative of a splendid opening, but it is merely suggestive. The point is to have a bureau established and its location is but a detail.

Sixth Canadian Good Roads Congress and Exhibition

THE Sixth Canadian Good Roads Congress and Exhibition will be held in the Parliament Building, Quebec City, on May 20, 21 and 22 next, and the officials of the Canadian Good Roads' Association anticipate that this will be the largest and most important convention of its kind ever held in Canada. It will meet under most favorable auspices. Since the last Congress, peace has wrought a great change upon the attitude of the governments and the public towards road building; federal aid has been promised and the provincial and municipal authorities are vying with each other in the promotion of highway improvement. In the meantime, also, the Association has obtained a Dominion-wide charter and has claim to the support of the whole country.

The preliminary programme is now being drawn up and will include addresses and discussions on such subjects as federal aid for provincial road building; highway maintenance; roads as an aid to agriculture; keeping the highways open in winter; "Shall we restrict the load or build the road to carry it?" contracts—the contractor and labor versus Government

construction of trunk or main roads; a school for highway engineering; also a number of papers dealing with the practical side of road building and maintenance, and the conditions for which the various types of roads are adapted.

Invitations to the Congress are now being sent out by Mr. Geo. A. McNamee, secretary-treasurer, from the association headquarters, 909 New Birks Building, Montreal, and it is expected that between 1,500 and 2,000 delegates will attend. Several members of the Quebec Provincial Government will be present, also three or more members of the Ontario Government and ministers from other provinces, as well as delegates from a large number of municipalities and all the various trade associations and other organizations interested in "Good Roads."

Eastern Ontario Good Roads Association

AS a result of certain reports that the Provincial Highway Department intended postponing the actual paving work on the Ottawa-Prescott road till the fall, the executive of the Eastern Ontario Good Roads' Association passed the following resolution

"Whereas definite assurances were given by the Ministers of the Ontario Government at the annual general meeting of the Eastern Ontario Good Roads Association at Ottawa on February 4th, 1919, that the building of highways in Eastern Ontario would be immediately proceeded with in 1919, and whereas articles in the daily newspapers of March 3rd and 4th indicate that such is not the intention of the Government, but that the construction of the roads was to be deferred, culverts and bridges only being undertaken in the meantime, we, the executive of the Eastern Ontario Good Roads Association in meeting assembled strongly protest against any delay in supplementing and implementing the assurance given regarding the construction of highways in Eastern Ontario for 1919, and we would ask that the construction of the roadbed go forward concurrently with the proposed concrete work, and that this meeting be brought to the attention of the Hon. Finlay McDiarmid, whose department is responsible for the carrying on of the work."

The executive also discussed plans for meeting the Highways Department of the Dominion Government with reference to supplementing the grant already promised for road building this year, with a further amount for maintenance purposes, a committee being appointed to arrange the proposed conference.

Other questions under consideration had reference to the linking up of the proposed provincial and county roads in the eastern counties of Ontario, a committee being appointed to co-operate with the various municipalities interested.

Channel Tunnel Again Discussed

INFORMATION is forthcoming from English sources that the British and French governments have definitely agreed to the construction of a tunnel under the channel, and that the details are now being discussed by a special commission in Paris, which is also considering the building of tunnels under the Bosphorous and the Straits of Gibraltar. It is stated that the engineering plans for the channel are so far advanced that work could be be-

gun immediately. According to the report, it is proposed to start the tunnel some distance inside both countries instead of near the coast, as was originally intended, so as to avoid the risks of a fall of the cliffs, such as has occurred on the British side, near the point where the work would have been begun. In addition to tracks, the tunnel is to carry telephone and telegraph wires, superseding the present seabed cables, and also pneumatic tubes for carrying letters and parcels. The French and British railroads concerned are willing to finance the scheme, but the two governments wish to exercise control, and some sort of joint state finance for the work may be adopted.

J. C. T. O. Annual Meeting

THE Joint Committee of Technical Organizations will hold their annual meeting in the Physics Building Theatre of the University of Toronto on Monday, March 24, at 8 p.m. The programme will consist of President Geo. A. McCarthy's annual report, in which he will outline the activities of this organization during the past year, which, we understand, have been very extensive. This will be followed by an address by Mr. H. J. Daly, on the subject, "Industrial Economics—the Employer's Standpoint." Mr. Daly has come into particular prominence as Director of Repatriation for the Dominion Government, which office he recently resigned, and is one of the best known industrial figures in the Dominion. The labor standpoint will be presented by Mr. Tom Moore, President Trades and Labor Council of Canada, who will speak on "Industrial Efficiency—From the Labor Standpoint." Mr. Moore is known as a labor man with very broad and sound ideas, and recognized as one of the outstanding figures in the solution of the problems confronting us at the present day of bringing labor and capital into closer working relationship.

Building Material Rates to be Cut

AS a step toward increasing building activities throughout the country, which is the one immediate hope of reducing unemployment, the United States Railroad Administration will in a few days cut down the freight rates on building materials of all descriptions from the present high level to the pre-war standard. The proposal, put forward by some of the leading economists in the country, has met the approval of Walter D. Hines, director general of railroads.

The cut will apply not only to material for general construction of buildings, but material for roads as well, in the hope that private interests will seize the opportunity with the opening of spring to let contracts generally.

Such a cut would, of course, reduce the price of lumber, bricks; cement and structural steel, and would be an invitation to those who are contemplating building to go ahead with the work. That, in turn, would give employment to a very large number of mechanics.

The Robertson Construction & Engineering Corporation, Limited, head office Niagara Falls, Ont., capital \$40,000. To carry on business as mechanical, electrical, hydraulic and civil engineers and contractors, etc.

Is There a Field For The Quantity Surveyor in Canada?

Successful in England—Why Not Here?

By Edward H. Beck

I HAVE been greatly interested in several articles which have appeared in the Contract Record on the subject of Estimating, Cost Accounting, etc., and am glad to hear that these subjects are being dealt with by the National Contractors Association and other organizations.

There are several very interesting points in the article by Mr. L. A. Griffin which appeared in a recent issue of the "Contract Record" which I think calls for some little explanation, but paves the way for some helpful discussion on the very much abused, but very important subject of estimating, as viewed not only from the contractor's side of the question, but also from the viewpoints of the owners, engineers, and architects.

The article referred to above mentions three different methods for overcoming the objectionable features of the existing hap-hazard method.

The first method mentioned is the bringing into existence of the quantity surveyor, a branch of the engineering profession which is little heard of in this country, but very much in evidence in England, where I served six years with one of the well known government contractors, and having followed the engineering and contracting business in this country for the last twelve years feel somewhat qualified to express my views, but wish at this point to say that I do so with all sincerity and do not wish to antagonize anyone if I find it necessary to criticize the views of others, and only hope that this effort of mine will draw forth helpful criticism from other quarters. It is only by such discussion and helpful criticism that we shall be able to arrive at some really sound and common-sense method, which is the object all are seeking who are interested in this question.

The reason the quantity surveyor has not come to the front in this country is attributed by the author of the article under discussion, to the possibility that the system "may lack the very things we most desire."

What are the things we lack and most desire, from his viewpoint as set out in the article?

(1) To do away with the non-remunerative work necessary under the present system of estimating.

(2) To devise a "safe, sane, and conservative method" of doing this work.

(3) To guard against "sharp practice" by either the owner, the engineer, or the architect.

From his remark as to the necessity of the contractor checking up the quantities before putting in his tender, I should infer that Mr. Griffin is somewhat confused as to the importance of the proposed bill of quantities. In the present system the plans and specifications form the basis for the contractor's tender, and I would like at this point to mention that beautifully vague clause which we usually find in any specification, and which runs something like this, but is in very many cases much more vague as to its meaning:

"This specification is to cover all—etc.—required in connection with the erection and completion of the work herein specified. Drawings, etc., accompanies this specification and are to form part of same, and anything shown on them or described in this specification or fairly implied by either or both, shall be executed as if explained and described."

"The drawings and specifications are intended to cover all the essential parts for the complete work, except where otherwise definitely specified, and anything omitted in the trades included in this contract which is essential to the workmanlike construction will be finished as though included in the drawings and mentioned in the specifications."

How nicely the above clauses cover up any carelessness there may be in the plans and specifications, and what a splendid foundation is laid for a lawyer upon which to base an argument either for or against.

Quantity Surveyor Discovers Errors

The bill of quantities takes first place, and replaces the plans and specifications in that respect. The fact of the quantities being taken off by a competent quantity surveyor, assures the plans and specifications being in accordance with them; the shortcomings or errors in either would be found out and the matter adjusted with the engineers or architects before the quantities could have been completed.

The fact of the quantities having to be taken off by the quantity surveyor, will insure for the future a much more finished product in the way of plans and specifications than, I am unfortunately bound to admit, is the practice with many engineers and architects of today. This may be an answer as to why the English plans are more often so much more of a finished and definite nature.

The quantity surveyor entirely does away with the non-remunerative feature from the viewpoint of the contractor, and places the cost of the estimating on the shoulders of the right parties, and at the same time the cost of the estimating is reduced to a minimum. It is not necessary for the contractor to check up the quantities as your correspondent says in his article, except after the contract is awarded to him. When the work is completed a final survey shows any deductions or additions to the contract, which is paid for accordingly.

Employ an Expert

Many architects' offices are large enough to warrant him employing a man to look after this branch of the work, but I am at present not very much in favor of this as I think it is altogether necessary and advisable to employ the quantity surveyor whose training and experience is everything, and to my mind the surveyor coming between the architect and contractor would perhaps be an additional guard against the desire expressed in our item (2), and would also somewhat relieve another of the clauses usually found in the specifications as to the architect's decision being final.

The contractor submits his price and is governed by the bill of quantities, and not by the plans and speci-

fications except in-so-far as they are necessary for him to properly size up the general nature of the work, and price the work intelligently.

Responsibility of Quantity Surveyor

If through error the bill of quantities does not contain an amount of work called for by the plans and specifications or which has been ordered by the architect or engineer to be done, then the contractor is paid for that work according to the unit prices which he has submitted, and on which he based his tender. The surveyor, however, in taking off his quantities must have a full knowledge of the work in hand, and his livelihood entirely depends on his accuracy and knowledge of his calling, just the same as in any other profession. Some may raise the point that we are depending too much on the surveyor under this method. Does not the owner depend entirely on his engineer for the safety of his design and does not the engineer's livelihood depend on the success he attains in his work?

To my mind we have all been too prone to suspicion of one another, instead of having more trust, but it is to be earnestly hoped that the splendid way in which the contractors are organizing will not only tend to create a more trustful intercourse between the individual contractors, but also between them and the engineers and architects, and I should like to emphasize the suggestion of obtaining the co-operation of these professions in investigating and arriving at some standard method of operation.

Irresponsible Contractors

With regard to the points raised as to "putting more contractors in the field" and having enough now of the kind who do not know how to figure work, nor how to do it after they have been awarded it; it seems to me it would only require one contract to put such contractors out of business, and, in fact, a careful study of the unit costs of his tender would tend to warn the engineers that this contractor was not up to the standard required for the work. All who know anything of the contracting business, especially during the last few years, will admit that the contractors who have a good reputation for quick and efficient work are the ones who prosper and very often get the work irrespective of their tender being the lowest. With materials and labor at its present high cost it is efficiency which is the contractors best stock-in-trade. It has been somewhat aptly put that engineering is the art of doing well that with one dollar, which almost any blunderer could do after a fashion with two dollars.

The item (2) outlined above calls for a "safe, sane, and conservative method."

The Englishman has either deservedly or otherwise acquired the reputation of being somewhat slow but very sure. Then is not the fact of the quantity surveying system having been tried out, and accepted, and still being in operation in England, proof that it is a very safe and sure method? Experience is the best teacher, and the English experience has been a long and varied one, and seems still to be very satisfactory. The same argument classifies it as a "sane" method. It is undoubtedly a safe method from the viewpoint of the contractor for he has something which is absolutely definite upon which to base his tender, and he is paid for the work he does and which is covered by the bill of quantities. He has not got to argue as to whether some work which he has done is an extra or

not; if that work is not in the quantities and he has been instructed to do it, then it is naturally an extra.

England has often been classified as being "behind the times," but is she so far behind the times as some people suppose? I think that question might very well be left to be answered by some of the engineers who have been "over there." The proverbial slowness of the English may also act as an answer to the "conservativeness" of the method.

Item (3) calls for the ability to guard against "sharp practice." Here we have the inevitable personal equation.

Unfortunately we always have the questionable element in any of the professions, but it is almost a universal law that like attracts like. A man in need of legal advice does not go to a lawyer whom he knows uses what is known as "sharp practice," unless he wants that lawyer to use his questionable tactics on his behalf, in which case he immediately places himself in the same category. An engineer in any branch of the profession, using questionable tactics, soon becomes known and is watched very closely by those who are unfortunate enough to have any business dealings with him, and therefore his business suffers accordingly.

Eliminates Sharp Practice

The fact of the work being awarded to a contractor whose price is based on the bill of quantities supplied to him for that purpose, eliminates so far as possible the use of sharp practice on the part of the surveyor. I cannot see very clearly how the surveyor is going to "put the quantities in such a way that they could be misconstrued." I do not realize very fully how many different methods are employed by different contractors in taking off their quantities, but surely this difference, can, and should be, eliminated, as being a part and parcel of the bad qualities in the existing method of estimating.

In a recent editorial in the Contract Record on "Standard Cost Accounting for the contractor," is put forward the splendid suggestion that a small committee consisting of men who have the reputation of knowing how to handle figures, and Accountants who have had practical experience in the cost of construction work, be appointed to standardize the system of Cost Accounting. Might I add to this suggestion that as the Cost Accounting affects the contractor in the same way as the quantity surveying, that a small committee be appointed **by each trade**, who shall not only endeavor to standardize the system of cost accounting, but also embody with it the drawing up of a sound, common-sense system of estimating. Each committee should be at liberty to get any and all information possible from all interested parties, and the co-operation of accountants, engineers, and architects should undoubtedly be obtained in the work,

Method of the National Contractors' Association

The second method mentioned is that of the National Contractors' Association, which I am not entirely familiar with, but which your correspondent remarks, "has the inherent weakness that too much depends upon the fellow who handles the bidding."

This method then, if such is the case, does not meet with the requirements contained in items (2) and (3). This may be overcome in some way and the result prove a better method than the quantity surveying, but not being in possession of the outline of

this method I am not competent to say anything further. Mr. Griffin, however, has evidently made a very exhaustive study of this method, and his lack of faith in it, as shown by his remarks, quoted above, and the clear way in which he points out the harm which could be done to the contractor, should cause those interested to endeavor to overcome these very important objections.

Nelson Plan

The third method mentioned is the Nelson plan, which, I should judge from your correspondent's remarks, is the plan calling for the payment by the owners to the contractors of a sum sufficient to cover the cost of the estimating.

One of the advantages claimed is that there is no "middle man." Is this an advantage? We are endeavoring to devise a scheme whereby the loss of time and money in the duplication of the estimating can be avoided. We cannot eliminate the estimating, but we have one man do the work once, and all reap the benefit. No one expects to get something for nothing, and after all it is hardly fair to say that the estimating done by the contractor is non-productive, for as your correspondent says, someone pays for it without knowing it. In other words it is part of the contractor's overhead expense which he figures in his contracts. This, then, makes another object which we should keep in mind, viz., the payment for estimates by the right party, but, we should not ask that party to pay several times for the work, for that is what we are endeavoring to avoid ourselves, and we must not get over our own difficulty by placing the same bad condition of affairs on to other shoulders.

It is without doubt a fact that the work of the man who has specialized in that particular branch of his profession, is and always will be, better than the work in that particular branch done by a man who endeavors to cover the whole of the profession generally. Experience teaches and practice makes perfect.

Duplication of Work Eliminated

Therefore the so-called "middle man" is, in this case, and in my humble opinion, very essential to the smooth working out of this proposition. By having him we eliminate the duplication of the work. We get a uniform and consistent bill of quantities from every engineer and architect on which to base our tenders. We know exactly what we are figuring on and have no further worries as to whether or not we have included such and such a thing in our figures. The owner is satisfied that he is paying for nothing further than what he is getting; he pays for his own estimate only and not someone else's as well and it costs him very little more to invite a dozen or two dozen contractors to figure on the work, than to only invite one or two. In many instances the contractor is very uncertain as to what is required, owing to the vagueness of the plans and specifications, therefore he adds to the item in his figures for "unforeseen contingencies." With a bill of quantities these contingencies are reduced to a minimum.

The most serious feature of the third method seems to be the sure result of the architects and engineers limiting the number of bidders, which would immediately create a system of discrimination which should be avoided above everything else.

Committees Should be Appointed

Summing up then, the method which seems to em-

body the best features for which we are aiming, and also eliminates, as far as possible, the worst features of the existing methods, appears to be that of the quantity surveyor. The co-operation and assistance of the engineers and architects together with the accountants should be earnestly sought. Committees should be appointed by each trade to investigate the possibility of adopting a standard for the quantity surveyor and also for the cost accountant. These committees should report to a general committee which should consist of contractors, engineers, architects and accountants. The quantity surveyors should then be asked to use the Standard as revised and accepted by the general committee. A standard form of tender might also be drawn up by the committee which should especially place the bill of quantities as the base on which the tender is submitted.

Indefinite Plans Responsible for High Cost

There seems to be in my mind so much in favor of the quantity surveying method that it is difficult to understand why it has not been in operation in this country ere this, especially as the plans and specifications issued by so many of our architects and engineers frequently leave so much to the imagination of the contractor. The result is that he puts a higher price on everything of which he is doubtful. Extras have always been a bone of contention, and much unnecessary friction caused thereby. How many contractors have found, to their cost, that an error was made in their quantities, but who had no redress under the old conditions?

One has only to observe the enormous differences which is more often than not the case between the different bidders for the same work. On page 193 of your issue of 26th February, is a report of the tenders received for the construction of a concrete conduit in Montreal. The seven prices received ranged from \$41,900 up to \$68,232, a difference of \$26,332, or more than 62 per cent. of the lowest tender. This is only one of very many such cases.

It may be decided by the committee that a nominal sum should be charged each contractor tendering for the supplying of the quantities, etc., but this suggestion, like all others, is open to discussion.

Employees Entertained

A special evening was given to the office employees of the Dunlop Tire & Rubber Goods Company, February 21st, by Mr. J. Westren, General Manager of the Company. The gathering, which convened in the company's head office building, included not only the entire head office and city branch staffs, but representatives from branches at Montreal, Ottawa, London and Hamilton.

Cards and dancing, interspersed with refreshments, made up the social part of the evening. Mr. Westren made a number of interesting announcements—the most interesting, perhaps, to the staff being one of a pecuniary nature, in which all shared. He also spoke of the broader field in sight for the company owing to the new affiliation with the larger British Dunlop Company by reason of which they have access to the methods and formulae of the latter company, sharing in the use of any new patents, etc. Mr. Westren spent a couple of months in England during the latter part of last year, perfecting plans for interchange of ideas between the companies.

Ontario Good Roads Association Holds 17th Annual Meeting in Toronto

FOLLOWING on the heels of the Conference of County Road Superintendents and Engineers of Ontario, the Ontario Good Roads Association opened the sessions of its 17th annual meeting in the York Building, Toronto, on the afternoon of March 5th, with a large and representative attendance. President C. R. Wheelock, county engineer of Peel county, in opening the meeting, referred to the auspices of peace under which this year's meeting took place, resulting in a renewed interest in the "good roads" movement and a consequent inception of plans for highway development of a most advanced character. Not only is the desire to reconsider delayed activities a factor in awakening interest in road progress, but the need of mitigating the unemployment situation is calling upon the various governments to initiate and complete all the public works possible, including aggressive road-building programmes. The indications are that, throughout the Dominion, active and progressive plans for highway development are in course of preparation. The amount of traffic, in Mr. Wheelock's opinion, is the determining factor in selecting the type of road to be constructed, inasmuch as the traffic density determines the classification and nature of the road. That county has the best system of construction which takes this point into consideration and builds the highways to suit the traffic. Mr. Wheelock commended the scheme of provincial subsidies and declared that the provincial highways were the most important links in the provincial transportation. He urged expansion in the building of roads throughout Ontario, inasmuch as roads are the measure of a people's progressiveness.

Motor Truck Traffic Must Be Considered

The effect of the motor truck was the topic of the talk of Capt. L. E. Allen, of Belleville. In the last two or three years, the destructive results of motor truck traffic on existing roads had been observed and they must now be designed to take this into consideration. In planning the new provincial highways, the fact should not be lost sight of that they will sustain a large volume of motor truck traffic and will be essentially motor roads. If the greatest benefit is to be derived from the provincial highways, they should, therefore, be planned for the motor truck. Mr. Allen favored some legislation restricting the size of trucks to prevent destruction of roads incapable of carrying the traffic.

Hon. F. G. Macdarmid, Minister of Public Works, made the statement that the Federal Government intends to set aside the provincial authorities with their road-building programmes. This federal aid will reduce the provincial and county contributions towards provincial highways. Highway work during the war has not been prosecuted vigorously, but according to the Minister, conditions are now different and there should be no obstacles to the carrying out of a comprehensive scheme of development. In fact, such a scheme is warranted to-day by the pressing need of

giving work to the unemployed. No better solution to the labor situation presents itself than the construction of permanent highways. Hon. Mr. Macdarmid explained the Highways Department's real object in furthering a system of provincial highways, in order that the misapprehensions concerning the roads might be dispelled.

Stone and Gravel Roads

The county road superintendent of Halton, J. G. Wilson, explained in a paper, "Stone and Gravel Road Construction," some of the salient features of roads of this type. His paper in abstract follows:

"The use of stone and gravel will hardly apply to provincial roads or provincial-county roads, as these will be called upon to carry a large amount of heavy traffic and a more permanent type of construction will, therefore, be necessary. The county roads intended as feeders to the above mentioned classes of highway, will, no doubt, be largely constructed of stone or gravel. In constructing a gravel road, it should be under-drained where necessary and culverts placed at the natural courses to carry the water across the road. The crown for a single-track road should be 1-inch to the foot. Open ditches with sufficient outlets should be provided so that water may not remain in the ditches to soak underneath and injure the road. This preliminary preparation of the road should be done one year before the metal is put on, in order to give it time to become consolidated. If not, it should be thoroughly rolled to harden the foundation, as good results cannot be obtained on soft or yielding sub-grade. Wet weather is a bad time in which to build a road. It is important to have the foundation hard and dry during construction, as well as in service.

Use of Bad Stone is Poor Economy

"The quality of the stone should be hard and tough and it is poor economy to use a poor quality for the sake of saving a few cents a yard. Not less than 10 feet should be the width of a single-track road, and the depth of the metal should be determined by the amount of traffic to be taken and the kind of soil on which it is built. For example, where the foundation is of a gravelly nature, with good natural drainage, a depth of 8 in. might be sufficient, but where the sub-grade is heavy clay, 12 in. might be better, in which case the road should be excavated to a depth of 6 in. and filled with coarse stone, thoroughly rolled when dry, followed by a second course of 1½ or 2 in. stone. The screenings are then put on, with plenty of water to make a slush. The water wagon should have wide tires to prevent rutting the road.

"In constructing gravel roads, length of haul is a big factor in determining the cost and should this bring the cost up to approximately the cost of stone, it should never be considered. An excellent material for roads contains pebbles up to 2 in. with just enough sand to fill the voids, and if the road is well-drained

and a sufficient depth of gravel used, it will stand up under quite heavy traffic.

Requirements of Good Gravel

"Dirty gravel should be avoided; while gravel with an excessive amount of clay will pack quickly, making a good road in dry weather, it will rut badly in spring or fall. A few stones are not objectionable if the gravel is otherwise good, as they can be raked forward and placed under the next load. A uniform grade of gravel is recommended.

Thursday Afternoon

The second session of the convention, on Thursday, opened with an address by Hon. Geo. S. Henry, Minister of Agriculture of Ontario, in which he commended the unexcelled system of highways developed by the Highways Department—a system which, he declared, does not burden the people with taxes or cause unfair taxation. Mr. Henry's plea for good roads extended to the minor roads as well as the thoroughfares, and it should be the purpose of road builders to construct all-season highways. The motor traffic had reconstructed all former ideas of proper designs, and in Ontario this must not be forgotten, as, owing to the agricultural nature of the province, the motor car would occupy a predominant place.

Federal Aid Secures National Co-operation

The president of the Dominion Good Roads' Association, S. L. Squire, felt that the intention of providing federal aid was but the culmination of the growing tendency to share responsibility. The history of road building gave indication of the fact that as time went on, responsibility was changing from individual to co-operative. Equalization has been assured by progressive legislation and now, the institution of federal aid is the latest step in this direction, securing national co-operation. Mr. Squire believed that a readjustment of provincial legislation of the apportionment of provincial contributions should be arranged to take cognizance of federal aid. Dominion assistance, in his opinion, should extend to every class of road in the province and not be granted to any one type of highway. In applying aid, the federal government will help select the roads, but will not define the location. In conclusion, Mr. Squire insisted that the municipalities should not be criticizing the government, but should act so as to make it easy for the government to give the money.

Road Maintenance

"Road maintenance" was the subject of a paper by F. A. Senecal, county road superintendent of Prescott & Russell. This is abstracted as follows:

"To my mind, an ideal organization for road maintenance should be prompt, systematic, and continuous

This organization should be prompt, because, when once the need of repairs becomes apparent, no good purpose is served by delay. The longer the delay, the more difficult it becomes to carry out the work and a source of liability for damages may soon be developed. Moreover, the action of the water remaining in the subgrade soon affects its firmness and will ul-

timately destroy the roadbed entirely. The organization for maintenance should be systematic, because the best results in roadwork are obtained only when a well-planned system of maintenance is scrupulously adhered to and followed to the letter. Finally, it should be continuous because no organization can be called complete unless the various sections are united together under the patrol system, which is generally followed on the county roads to-day.

"There are a few other points which, I believe, should always be borne in mind by the superintendent when laying out his plans for heavy maintenance work on the roads. These are the proper location of the graded roadway, and also the question of providing sufficient drainage for the roadbed. No labor can be employed more profitably than on the proper location of the road, and, having done this, on placing of the under-drains wherever required, thus ensuring a perfectly dry roadbed before beginning the work of constructing with stone. These two points cannot be too strongly emphasized because the conditions of the soil and other matters vary so much that each wet spot seems to present a problem of its own. It is always desirable to have this solved before attempting any road construction.

"The tools generally employed to maintain the roads are graders and drags. With proper handling these tools render excellent service, but sometimes they are useless in the hands of an incompetent man. I have heard the statement made to me that drags are useless to maintain earth roads. Upon investigation into the matter I found that they had been experimented with under most unfavorable conditions.

When to Use a Drag

"My experience indicates that the proper time to use a drag on the roads depends on two factors, to wit: the nature of the soil, and the traffic over the road. An earth road mixed with gravel should be dragged when very wet, as also when the traffic is light on any road. But, when the traffic is considerable it is useless to drag it until the earth has sufficient body to prevent cutting by the wheels of vehicles. This matter, however, can be easily adjusted by giving a few trials with the drag under the various conditions of the road.

"There is also another matter in connection with road maintenance that seems to be overlooked because it does not affect all the counties of the province to the same extent, that is, to the maintenance of winter or snow roads. In the northern part, as also in eastern Ontario, snow plows and rollers are used in many localities. Both have their merits, but considering the uncertainty of the snowfall in some parts of the province, the ordinary land roller answers the purpose quite well. It is much better to begin when there are eight or ten inches of snow over the road and roll the road after each snow storm if the best results are to be obtained. If its use is delayed until there is a foot or two of snow over the road it is practically useless to roll the road. The action of the roller in packing down the snow provides a smooth road, free from "pitch holes," which are sometimes prevalent during winter.

Co-operation Adds to Success of Maintenance

"In conclusion, I must say that the success or failure of road maintenance depends largely on the spirit of hearty co-operation among all the men connected with the work. Nothing should be neglected



Mr. F. A. Senecal,
Prescott & Russell Co's.

that will tend towards this end. The superintendent should endeavor to create some emulation among his foremen with the view of obtaining the best results for the money expended by each of them."

Major T. L. Kennedy opening a discussion on this paper, commended the maintenance of the old Roman roads in England and France, on which there were parties of only two or three men doing repair work all the time. These roads were kept in excellent shape simply because no hole was left unrepaired, but was attended to immediately upon its discovery. Mr. Senecal, replying, recommended the patrol system by which repairs can be carried out immediately upon the detection of defects so that water will not destroy the foundations as well as the surface.

Resolutions

The resolution committee, K. W. McKay, chairman, brought in a number of questions about which considerable discussion took place. Mr. McKay felt that legislation must be arranged with a view to obtaining equalization of opportunity and expense. To get full equalization of effort in townships, he felt that the property in townships should be fully assessed, and as an example of mis-placed assessment, he cited instances of property along the Toronto-Hamilton highway that was assessed in 1918 for less than 1914, in spite of increased values and accrued benefits derived through the establishment of the road.

The first resolution favoring the application of provincial and federal aid for the construction and maintenance of connecting links or extensions of county roads through Indian reserves, was carried unanimously after an explanation of the conditions by members of one of the Ontario reserves. A resolution urging that provincial aid towards the salary of township road superintendents be increased from 25 per cent., as at present, to 40 per cent., was amended to read 50 per cent., and carried. The association sent a resolution of commendation to the provincial Highways Department, approving of its policy and promising support.

Statute Labor a Point of Discussion

That keen interest is taken in the question of statute labor was manifested by the discussion that followed the placing before the association of a motion advocating its abolition, in the maintenance of roads supported by public funds, substituting therefor the appointment of township road superintendents to supervise repair work. Several members of the association favored the retention of statute labor, proclaiming the good work it had done in the past when properly handled and systematized and under the supervision of efficient overseers. Others advocated its commutation, chiefly on the grounds of its inefficiency, but many were inclined to let legislation remain in as much as the abolition of statute labor is now optional with the townships. A close vote gave the resolution a favorable majority. The Deputy Minister, Mr. W. A. McLean, was satisfied that the system worked well, but had come into disrepute through the selection of poor superintendents.

One member characterized as class legislation a resolution to the effect that in mining localities where trucks are used for hauling, and are destructive to the highways, the province be asked to build light steam or electrically operated railroads along the roads. After discussion this resolution was lost, although it was pointed out that such railroads would

serve to haul road building materials. The old-time question regarding the building of entrances from highways to farms was covered by an unanimous resolution asking that the Highways Department arrange for the presentation of a stated case to determine a decision in the matter.

Further Resolutions

An amendment to the Municipal Act was recommended in a motion providing for the use of private property for the diversion of water from highways. The members of the association also advocated the repeal of the legislation preventing the deposit of gravel on roads during winter months. Other resolutions that were adopted concerned the reduction of freight rates to a pre-war basis and the purchase by the Highways Department of stone quarries or gravel pits to supply materials to municipalities who cannot get them readily.

A motion to ask the counties to pass resolutions commending the system of provincial highways to add weight to the resolution passed by the Association, elicited a great deal of discussion. The attitude was finally taken that such a resolution seemed to apply undue force on the counties and it was withdrawn. Severe criticism was made during the discussion, of those who call the provincial highways, speedways, and belittle their commercial uses. The use of the fines from speeding on provincial highways for the maintenance of these roads was advocated.

Major Kennedy, speaking at the final session of the conference, mentioned the efforts of the Eastern Ontario Good Roads Association, which had taken up the question of provincial county roads and advocated the construction of these by the province. On behalf of Mr. Findlay, past-president of that association, Major Kennedy submitted a motion to this effect, but the consensus of opinion was that this was asking the province to do too much and; further, would disrupt the provincial organization and the county's construction forces. In view of the fact that the Province had promised to do so much, it was felt that the counties should assume some obligation and the motion was lost.

Simple Methods Solve Road Problems

Mr. A. W. Campbell, C.E., of Ottawa, Dominion Highway Commissioner, declared that there was no sentiment attached to road building, but that the problem was a business proposition to be settled in a business-like way. For 25 years he had been preaching "Good Roads," and although there have been changes in road requirements and construction systems in that time, the same fundamental principles obtained. There is, in these pretentious days, he declared, a tendency to forget the simple methods of solving a simple problem. No new methods are needed: the old ones are applicable and these are combined into a simple formula which Mr. Campbell stated as: Plan wisely, construct skillfully, maintain diligently. His interest, Mr. Campbell maintained, is always in roads—not provincial roads, or federal roads, or county roads, but all roads; for roads are the life of our country and, but for them, railways and waterways would sink into insignificance. He was concerned with the earth roads as much as the best concrete road and with the back-woods road as much as the trunk line.

Speaking of the promised federal assistance, Mr.

Campbell characterized it as but a further realization of the need of joint responsibility and joint assistance. The administration of national, as of provincial aid is just a means of arriving at fair taxation. The establishment of federal assistance does not remove control out of the hands of the Province, nor does it mean that municipalities are to be any less stringent in their road-building programmes. Interest must not be allowed to lag in the development of roads and side roads must not be forgotten for the sake of furthering the trunk highways. After applying provincial and federal aid, there are still 240,000 miles of road in the country to be handled by the municipalities without assistance, and this will always keep the problem alive. In administering the national funds, Mr. Campbell emphasized the fact that no money would be wasted and no municipality need apply for assistance to build a surface if the foundation were poor. The Federal Government will contribute towards the construction of a good foundation as a first essential, but will not tolerate poor methods of road building.

Dr. Riddel, of the Labor Bureau, had a few words to say of the labor situation, the government's share in the solution of the difficulties and the value of giving employment by road-building.

Stratford Builders' Exchange

Messrs. T. R. Wright, secretary-treasurer of the Provincial Builders' and Supply Association, and E. R. Dennis, of London, were invited last week to address an open meeting held by the Builders' Exchange of Stratford, Ont., in the city hall of that city, on Thursday evening, March 6th, which was attended by a large number of builders and contractors, as well as many other citizens, including acting Mayor Stevenson, the principals of the Normal School and



Mr. T. R. Wright, Secty.-Treas. of Provincial Builders and Supply Association

the Collegiate Institute, the president of the Trades and Labor Council, and members of the City Council, and other municipal bodies.

Mr. Wright addressed the meeting on the work the association was doing, and referred to many spe-

cific instances in which it was proving of definite benefit to the building interests of the Province.

Acting Mayor Stevenson, in a brief address, referred to the interest shown by the builders of Stratford in all matters relative to the process of the city, and also spoke of present widespread interest in vocational training, and the desire in many quarters to extend Stratford's facilities for technical education.

Mr. E. R. Dennis gave a half hour's address on the relation of the technical school to the training of apprentices in the industries. He advocated more liberal government grants to technical schools, a national system of uniform education for all the Provinces, and the part-time method of training apprentices, the factory and school co-operating in the development of the boy. He declared that a return to the apprenticeship system on modern ideals was an urgent necessity.

In the ensuing discussion, interesting contributions were made by Mr. J. J. Mason, manager of the Globe Werneckie Co., Principal Mayberry of the Collegiate Institute, President Semple of the Trades and Labor Council, Mr. R. G. Marson and others.

President Lillow of the Stratford Builders' Exchange, presided, and introduced the speakers.

New Construction Company

A NEW construction company has been formed in Toronto, known as the Carswell Construction Company, with offices at 58 Wellington St. East. The personnel consists of Messrs. J. B. Carswell, J. R. Hagelin and Geo. E. Wishart. Mr. Carswell has for some time past been chief engineer on construction work for the Aviation Department of the Imperial Munitions Board. Previously he represented Messrs. Ross & MacDonald, architects, in Ontario, during which time he was responsible for many of the large buildings in this district, including the Union Station, Royal Bank Building, Central Technical School, Toronto Arena, etc. Mr. Wishart was formerly auditor with the Toronto General Trusts Corporation, and later secretary of the Munitions Board, Aviation Department. He will be in charge of the financial end of the company. Mr. Hagelin, who was formerly chief assistant engineer with the Aviation Department, will be in charge of the outside work. Mr. Hagelin is an expert on reinforced and mass concrete work in the United States and Canada. Before joining the Munitions Board Construction Department he was superintendent for the C. P. R. on the Windsor Street terminals, Montreal. The company would seem to have a bright future. They have already started operations on the construction of the large Frazee building and an addition to the office buildings and warehouses of Gunns Limited in West Toronto.

Recent Incorporations

Suburban Water, Limited, head office Montreal, capital stock \$600,000.

International Engineering Corporations, Limited, head office Toronto, capital \$750,000.

The Kingdon Mining Smelting & Mfg. Co. Limited, head office Montreal, capital \$750,000.

The Border Cities Improvement Company, Limited, head office Windsor, Ont., capital \$15,000. Authorized to carry on real estate and contracting business

Ontario's Highway Organization

By C. R. Wheelock, C.E.*

THE first highway legislation of Upper Canada enacted in 1793, authorized Justices of the Peace to be highway commissioners with overseers elected at parish meetings, who were under orders from the commissioners to repair roads, bridges and streets. It was also their duty to see that landowners fulfilled what had been known in England as "statute duty." This was the beginning of what is generally known as "statute labour" and under this system, the most of the roads providing transportation for the early settlers were built and maintained. The Statute Labor Law provided a means of opening up the original roads of this country when money was scarce and settlers few and far between, and, although it was not without its limitations, it solved most of the problems of land transportation for the greater part of last century. But the road laws were suitable and worked out more or less satisfactory in the Province of Upper Canada in the nineteenth century are not suitable for the twentieth century conditions now surrounding transportation in the Province of Ontario. The statute labor system has outgrown its usefulness. Township councils have been slow to acknowledge the disadvantages of this system for present-day road building, and still cling to it at the sacrifice of good roads and economy, but many townships now appreciate the advantages of the later systems and as a consequence statute labor has been abolished in one hundred of the most prosperous townships in the province. In fifty of these, road overseers have been appointed to take charge of the roads, as provided by the Ontario Highways Act, and twenty-five per cent of the salaries of such overseers is paid by the government.

Toll Roads

The old system in vogue had not been able to keep pace with the need for well-built post roads and about the year 1830, to meet this problem, toll companies were formed to finance this work. Thus the day of the toll-bridge and toll-road was ushered in. During the next twenty-five years many toll-bridges and toll-roads were built. As toll companies whose duty it was to maintain the roads were more inclined to pay dividends than to spend the money in making necessary repairs, nothing was laid out on the roads that could not be avoided.

In 1874, county councils were authorized to take over township roads with exclusive jurisdiction over them. Municipal councils could take toll to defray the expenses of building or repairing plank, macadam or gravel roads. In 1889, an Act was passed to facilitate the purchase of toll-roads by municipalities. On roads so purchased all tolls were abolished, and the roads maintained by the county. But until the Highway Improvement Act was passed in 1901 there had been no satisfactory solution of the toll-road question, and a number of these roads were still in the hands of private companies, but have since been embodied in the county road system assumed under this Act.

To meet the changing conditions and demands of the people the Highway Improvement Act was amended from time to time and was supplemented by the On-

tario Highways Act in 1915 and the Provincial Highway Act in 1917. This covers highway legislation up to date but it has been announced that further legislation will be considered at the present session of the legislature, and that the long deferred bill providing federal aid for highways will be submitted at the present session of the Dominion parliament.

Ontario's highway laws provide for a classification of the roads according to the traffic they have to carry, and this classification forms the basis for government aid. The required classification as described in a recent annual report of the Deputy Minister of Highways, is as follows:

Provincial Highways

A system of Provincial Highways has been authorized by the Provincial Highway Act of 1917, with a view to the construction and maintenance, under the Highways Department, of leading highways throughout the Province. A highway from east to west across the Province would be the main artery of such a system, with suitable connecting branches leading to important terminal points.

The Act authorizes the Provincial Highways Department to take over any public highway as a provincial highway and be responsible for its proper construction and maintenance. For this purpose the Department has the usual powers of municipal corporation to widen or deviate the road allowance, procure material for construction, purchase machinery, and in general to control the use of the highway under the usual responsibilities placed upon municipalities.

Adjacent to cities the cost is borne in the proportion of 40 per cent by the province, 30 per cent by the city, and 30 per cent by the municipality through which the road passes. Outside of the suburban section, the province assumes the portion levied on the city, thereby paying 70 per cent and the local municipality 30 per cent. In the case of bridges, the local municipality pays 60 per cent and the province pays the balance. In cases where a special type of pavement is desired by a locality, provision is made for levying any excess part of the cost on a frontage basis.

All costs of surveys, the purchase of machinery, plant and equipment, land for widening or deviating, general overhead and staff expenses are to be borne entirely by the province. Thus the local municipalities will in effect, be required to pay less than 30 per cent of the total cost.

Cost Basis

A fundamental basis upon which the cost is distributed is that each local community should be required to pay for a road suited to local requirements. It is unfair to the rest of the province to levy less than that amount. It is unfair to the local municipality to require it to pay the entire cost of a road carrying an excessive amount of through traffic. The difference between the cost of a road suited to local requirements, and one of a character suited to the traffic of a main road, is therefore to be levied upon cities immediately served, or is to be met by the provincial from the revenue from motor vehicles.

Provision is made under the Ontario Highways Act, that a city may co-operate with the county coun-

*Before Conference of County Roads Superintendents and Engineers.

cil in improving the leading county roads adjacent to the city, and thereby obtain a more substantial type of construction for such suburban roads.

A commission is appointed to determine the roads and the length of each adjacent to the city to which the city would contribute. For construction, the province contributes 40 per cent and the county and city 30 per cent; for maintenance and repair the province 20 per cent and the county and city divide the remainder equally between them.

The section of county road designated as "suburban" remains a county road for which the county is responsible; the work of construction and maintenance to be carried on under the county road superintendent, but subject to the instructions of the special commission.

Provincial County Roads

Co-operative with Provincial Highways, but under county control, certain roads may be designated by the Highways Department as "provincial county roads." To such roads the province will contribute 60 per cent of the cost of construction and maintenance. These roads are intended to enable the more equitable maintenance of certain county roads, carrying a considerable portion of through traffic, but which the county may efficiently maintain, and which are not of sufficient importance to be classed as provincial, or which it is not desirable, or expedient, for the province to assume as provincial highways. They continue to be county roads, but because of heavy through traffic, will receive an increased subsidy. In general, they will form branches of the provincial highway system, joining up cities and other important terminal points of traffic. They constitute an intermediate link between the provincial and county road systems, and may be subject to special regulation.

County and Township Roads

County roads are essentially the market road—the farmers' roads. They radiate from market towns and shipping points, and meet the needs of accumulated farm traffic. The aiding of these market roads by the province is an effective means of assisting townships in their road improvement, in that township councils are thereby relieved from the burden of their most expensive roads, and can devote their energies to the improvement of less travelled roads, comparatively inexpensive to maintain. County roads are aided to the extent of 40 per cent for construction and 20 per cent for maintenance.

Township roads consisting of roads provided to carry the ordinary local traffic of a township are entirely under the jurisdiction of the township council.

Township councils have authority to pass by-laws to commute or abolish statute labor; about one-quarter of the townships have done so and the number is steadily increasing.

The highways department is encouraging all townships to place their road expenditure in charge of a permanent road superintendent, or foreman and to this end will pay (under the Ontario Highway Act, 1915) one-quarter of the salary of such official; the provincial grant not to exceed \$150.00 annually.

Type of Construction Depends on Traffic

All roads receiving government aid must be built and maintained up to the standards required by the regulations of the Highways Department. The broad principal is laid down that the type of road must be suitable for the traffic it will have to carry, but the se-

lection of the particular type to be used on any road is left to the municipality, subject to the approval of the department. All construction work from the foundation to the surfacing of the road, must be intelligently designed in accordance with correct principles of road building, and the work carried out in a systematic manner. Plans and specifications for the improvement of provincial county roads must be approved by the department before work is commenced.

The road organization of Ontario is centralized in the Department of Public Highways, under the Minister of Public Works and Highways, and is in charge of a Deputy Minister, Chief Engineer and staff. This department has the complete jurisdiction over provincial highways, and has the administration of the Acts which provide for subsidies to suburban and county roads. This puts into the hands of the department sufficient control to assure the uniformity and co-operation so necessary in building up a provincial system of roads.

Road Superintendents

A road superintendent is appointed by the council of each county, who takes charge of all the work in connection with the county roads system. He is an officer of the county council but must carry out the regulations of the department of highways and in respect to this the council must not interfere.

The success or failure of a county roads system depends to a great extent on the selection of a capable road superintendent, inasmuch as the county organization for carrying on the work of construction and maintenance is entirely in his hands. The superintendent who thoroughly understands all the different phases of his work will soon gain the confidence of the county council and will be consulted by them as an authority on all road matters. He is then in a position to suggest and direct the policy of the council along lines that assure the best results. On the other hand if road matters are left entirely to the initiative of the councils the policy will change yearly as the councils change, resulting in much confusion in carrying on the work.

The fact that Ontario's highway organization is centralized in one head with sufficient control of all main roads, makes it possible to have that uniformity of construction and co-operation of municipalities that will create a connected system of roads provincial-wide. The ordinary county roads when completed will form an excellent system of local market roads located in every part of the province. The provincial county roads will link up all county systems and provide for through traffic. They will merge all county roads into one connected system reaching every county and town in the province. The provincial highways will link up large cities and important terminal points, will provide for the heaviest class of inter-city and long distance traffic, and form the last link in a splendid provincial system of roads.

The Southern Canada Power Co. has completed the construction of its new dam and power house at Drummondville, P.Q., and is now installing the electrical equipment. The dam, of concrete, is 1700 feet long, of which 1440 ft. is an overflow section. The power house and transformer house are of concrete; the former is 71 x 66 ft. and the latter 37 x 100 ft. The contractors are Messrs. Morrow & Beatty, Ltd., Peterborough, Ont.

Steel Industry the Barometer of Trade

"WIRE Nails and Kindred Products," was the subject of an interesting address given by Mr. F. H. Whitton, general manager of Steel Company of Canada, Hamilton, before the Hamilton Convention of the Ontario Retail Hardware Association.

Referring to the steel business, Mr. Whitton said:

In times of peace, conditions in the industry have been called "The Barometer of Trade," and when you add the insatiable demand for the war that has occupied us during the past four years it reaches a place of importance held by no other commodity.

The wisdom of building up and owning a steel industry in Canada was demonstrated beyond contradiction when within just a few months of war being declared, the steel plants of this country had without hesitation plunged into what was to them a hitherto unexplored field, and produced successfully munition steel in large quantities and of a quality that has from that date to this not been surpassed on this continent or in all Europe. This country's accomplishment in that line has received from all qualified quarters at home and abroad the highest commendation and the service the Canadian steel companies have rendered in this war has many times repaid to its citizens, the Mother Country, our sister Dominions and our Allies all the money that has been spent since its inception, in its upbuilding.

It may be of interest to give you a little information in regard to the changed conditions brought about by the war.

Great Britain entered the war with about seven and a half million tons of steel. To-day her capacity is ten or eleven. A material portion of this increase was special for war needs and a considerable percentage of it may not be continued as suitable or economical for commercial purposes. On the other hand, there is no question she has learned the value of being more self contained and will manufacture a large portion of what she hitherto bought from Germany.

Germany's Production

Germany's production of steel in 1913 was eighteen million net tons, a capacity in some years 40 per cent greater than her own domestic demands, and for this surplus she created export markets at prices below actual or natural costs of production by granting subsidies in the shape of preferential railway rates, export bounties contributed by all engaged in making the article from the ore down to the finished product, government shipping aid to carry the goods to destination and finally banking assistance by advancing the cash promptly to the manufacturer against shipping documents, assuming any credit as to time given the purchaser and the collection of the account. Incidentally I might mention labor also has accepted less wages on goods made for export.

This will enable you to understand why German goods were so attractive in price and the extent to which all purchasers of German goods exported, contributed to the upbuilding of German manufacturing.

Germany's prominent advance into the iron and steel business was due to the acquisition of the coal properties gained in the war of 1812 and the ore prop-

erties when Alsace and Lorraine were ceded in 1871.

During the present war Germany seized last year, a large portion, nearly nine-tenths, of all French deposits of ore and in addition 95 blast furnaces.

Marvellous Results

The increased production of steel in Canada as outlined is representative of a great many other goods manufactured in Canada. When the call came to produce we accomplished somewhat marvellous results. More headway was made in four years, due to the necessity of war, than might have taken place in a much longer period under peace conditions. These industries are an asset to this country and every citizen a shareholder, either by direct or indirect interest, and you as distributors of the goods, together with we manufacturers representing the makers of them, are in reality the Board of Directors, who must devise a means of operating them in the interest of Canada.

Let us scan the field of our operations.

Fundamentally our basis is sound. We have a wonderful future before us to develop this great heritage of territory—rich in natural products of the mine, forest and waters—a soil capable of creating a great harvest of wealth—a climate that produces both vigorous crops and manhood—an intelligent, peaceful and contented people.

Buy Canadian Made Goods

Ottawa has arranged large orders for rails, track fastenings, locomotives and cars for the several Canadian railways. Large expenditures are contemplated for public works, good roads and similar work and the question now arises, "What are both the Canadian Manufacturers and Wholesale and Retail Distributors Going to Do?" Are they going to buy Canadian made goods, which will employ Canadian labor and keep their money in Canada to further circulate and produce new business, or are they going to continue to import foreign goods and help to give employment to the labor and manufacturing plants of some other country? We can well afford to eliminate any discussion of what has been done in the past, or why. Whatever the cause, the bald, naked necessity of the present to give employment to the citizens of this country and our presently returning soldiers, in short our "Commercial Self Preservation" calls on us, without admitting the possibility of any other decision, to buy and handle goods made in this country to the limit of every man and woman's power, and you gentlemen should unreservedly pledge yourselves to this policy during this conference. Place your decision on record and advertise it from one end of the country to the other as an example for others to follow.

Correction

In Mr. Geo. Hogarth's paper on "Road Foundations, Drainage and Culverts," appearing in the March 5th issue of the Contract Record, on page 198, the mix of concrete used as a foundation for city pavements is given as one part cement, two parts sand and five parts crushed stone.

Mr. Hogarth writes that the usual mix used for this purpose is one part cement, three parts sand and six parts crushed stone.

The Three Rivers Construction Co., Ltd., has been incorporated with a capital stock of \$50,000, to carry on business as general contractors at Three Rivers, P. Q.

Mineral Production in Canada for 1918

THE Mines Branch, Department of Mines, has just recently issued a Preliminary Report of the Mineral Production of Canada during the Calendar Year 1918. This report has been prepared by John McLeish, B.A., chief of the Division of Mineral Resources and Statistics, and contains a considerable amount of valuable information. We are therefore making a brief abstract of it in the following paragraphs, including such information as is of particular interest to our readers:

The total value of the metal and mineral production in 1918 was \$210,204,970. Compared with the production in 1917, valued at \$189,646,821, an increase of \$20,558,149, or 10.8 per cent., is shown, while compared with the production in 1913, valued at \$145,634,812, there is shown an increase of \$64,570,158, or 44.3 per cent.

While, during the past three years, greatly increased prices of metals and mineral products have contributed in large measure toward increasing the total value of the mineral production, it is satisfactory to note that out of about 45 items, or products, included in the mineral record, treating clay products and stone quarries each as a single item, no less than eighteen products have reached their highest production in actual quantity in 1918 or 1917.

The production of cement, clay products, stone quarries and other materials of construction was, as compared with maximum production before the war, reduced almost one-half because of the enforced cessation of building activity, whereas the production of metals and of various non-metals and fuels, most of

which entered either directly or indirectly into war's requirements, was greatly increased.

Comparing broadly the production during the past two years, it will be noted that more than half the total increase has been due to the higher prices obtained for coal, and a considerable proportion of the balance of the increase to higher prices of silver, cobalt, and asbestos, though each of these products, with the exception of silver, was also produced in greater quantity than in the previous year.

The metal production in 1918 was valued at \$113,563,111, an increase of \$7,107,964, or 6.7 per cent.

The metals, cobalt, lead, molybdenum, nickel, silver and zinc all show increases in production. Gold and silver were less in quantity than in 1917 by very small percentages, while in total value, gold and copper also exhibited a decline.

The total value of the non-metallic production, including clay and quarry products, in 1918, was \$96,641,859, as compared with \$83,191,674 in 1917, showing an increase of \$13,450,185, or 16.2 per cent. Excluding clay and stone quarry products, an increased production of which was hardly expected, almost every product on the list was obtained in greater quantity and value than during 1917. The principal exceptions were natural gas, mica, gypsum and graphite.

The table herewith shows the comparative mineral production by provinces for the years 1917 and 1918.

Below is a tabulation of structural materials and clay products, and other materials which are used to some extent in the building industries, showing the quantity and value of production for 1918 and the increase or decrease compared with the previous year:

Structural Materials and Clay Products		Quantity	Value	Increase (+) or Decrease (-) in quantity.		Increase (+) or Decrease (-) in value.	
Cement, Portland	Brls.	3,591,481	\$7,076,503	—	1,177,007	24.8%	— \$647,743 8.4%
Clay Products (\$4,599,835)							179,203 3.8%
Brick, common	No.	171,921,837	1,915,490				
Brick, pressed	No.	38,317,751	626,311				
Brick, moulded and ornamental; terra cotta			43,442				
Fireproofing	Tons	27,912	224,587				
Hollow Building Blocks	No.		43,087				
Kaolin	Tons	863	19,299				
Pottery			131,242				
Refractories; fire clay, etc.			397,458				
Sewerpipe			699,784				
Tile, drain	No.	19,616,261	499,135				
Lime	Bus.	6,270,666	1,856,819	—	296,504	4.5%	+ 298,332 19.1%
Sand-lime brick	No.	16,824,858	213,680				
Sand and gravel (not complete)	Tons	5,685,334	1,786,528				
Slate	Sq.	933	5,124				
Stone (\$2,873,175)—							— 366,972 11.3%
Granite			645,850				
Limestone			2,134,283				
Sandstone			93,042				
Total structural materials and clay products			18,411,664				— 1,425,647 7.2
Other Material Used in Building Industries—							
Copper, value at 24.628 cents per lb.	Tons	118,415,829	29,163,450	+	3,188,497	8.4%	— 524,530 1.8%
Iron, pig, from Canadian Ore	Tons	47,444	1,204,703	+	1,422	3.1	+ 435,920 56.7
Iron ore, sold for export	Tons	112,886	469,352				
Lead, value at 9.25 cents per lb.	Lbs.	43,846,260	4,055,779	+	11,269,979	34.6	+ 427,759 11.8
Nickel, value at 40 cents per lb.	Lbs.	92,076,034	36,830,414	+	9,745,754	11.8	+ 3,098,302 9.2
Zinc, value at 8.159 cents per lb.	Lbs.	33,663,690	2,746,620	+	4,094,926	13.8	+ 105,803 4.0
Asbestos	Lbs.	141,462	8,936,805	+	4,415	2.9	+ 1,740,396 24.1
Gypsum	Lbs.	39,365	1,016,765	—	184,045	54.7	— 58,978 6.7

Mineral Production by Provinces, 1917 and 1918.

	1917.		1918.		Increase (+) or Decrease (-)	
	Value of Production.	Per cent of total.	Value of Production.	Per cent of total.		
Nova Scotia	\$ 21,104,542	% 11.13	\$ 22,754,780	% 10.83	+	\$ 1,650,238
New Brunswick	1,435,024	0.76	2,111,816	1.00	+	676,792
Quebec	17,400,077	9.18	19,534,409	9.28	+	2,134,332
Ontario	89,066,600	46.96	94,084,420	44.76	+	5,017,820
Manitoba	2,028,264	1.39	3,197,697	1.52	+	1,169,433
Saskatchewan	860,651	0.45	888,500	0.43	+	27,849
Alberta	16,527,535	8.71	23,298,118	11.08	+	6,770,583
British Columbia	36,141,926	19.06	42,080,741	20.02	+	5,938,815
Yukon	6,482,202	2.36	2,248,598	1.07	-	2,233,604
Dominion	189,646,821	100.00	210,204,970	100.00	+	20,558,149

Iron Ore—The total shipments of iron ores from Canadian mines show a further falling off in 1918, being only 206,820 short tons valued at \$863,186, or an average of \$4.17 per ton compared with shipments in 1917 of 215,302 tons valued at \$758,621, or an average of \$3.52 per ton. The 1918 shipments included 8,153 tons from Quebec; 197,637 tons from mines in Ontario and about 900 tons mined in British Columbia. The ores comprised 170,907 tons of hematite and roasted hematite and siderite, 28,559 tons of magnetite, 6,324 tons of ilmenite and titaniferous ore, and 900 tons (dry) of bog ore.

The principal operations were as usual in Ontario at Helen and Magpie mines of the Algoma Steel Corporation, Ltd., all the ores mined being first roasted in the rotary kilns at Magpie before shipment. The magnetite properties at Sellwood were operated throughout the year by Moose Mountain, Limited, with an important production of briquettes from the milling and briquetting plant. The ore milled averaged about 33.8 per cent in iron, while the briquettes produced contained about 61.1 per cent iron. Shipments of less than 5500 tons were made from two small properties in Eastern Ontario.

In the Great Lakes region ore prices during the first half of 1918 were: Old Range Bessemer, \$5.95 per gross ton; Messabi Bessemer, \$5.75; Old Range Non-Bessemer, \$5.20, and Messabi Non-Bessemer, \$5.05. During the last half of the year these prices were increased by 45 cents per ton.

Mine operators reported approximately 112,886 tons of ore exported to the United States and 93,804 tons shipped to Canada furnaces. The Customs Department records show exports of iron ores, 1330,250 tons, valued at \$650,502 and imports amounting to 2,200,838 tons valued at \$5,895,974.

Pig Iron—Subject to a possible slight variation when final returns shall have been received the total production of pig-iron in Canada in 1918 excluding the production of ferro-alloys was 1,194,000 short tons having a value of \$33,000,000 as compared with a total production in 1917 of 1,170,480 short tons valued at \$25,025,960. Of the total productions 1,163,520 short tons were made in blast flames and 30,425 tons were manufactured in electric furnaces from scrap steel, chiefly shell turnings. In 1917 the blast furnace production was 1,156,789 tons and the electric furnace production from scrap steel was 13,691 tons. Thus, although the total production of pig-iron was greater than in any previous year the blast furnace production was less in 1918 than the output of 1916. The recovery of high grade low phosphorous pig-iron in electric furnaces from steel turnings was in 1918 nearly two and a half times the production in 1917, the first year that these operations were undertaken.

The production of blast furnace pig-iron in Nova Scotia in 1918 was 415,870 tons as against 472,147

tons in 1917 and with the exception of the year 1914 was the smallest production in this province since 1911. In Ontario the production of blast furnace pig-iron was 748,258 tons as against 648,642 tons in 1917 and was the largest production made in this province.

Pig-iron was made from scrap in electric furnaces in 3 provinces: 7,499 tons in Quebec and 22,976 tons in Ontario and British Columbia, the production in the latter province being a little over 1,000 tons.

By grades the 1918 production included: Basic, 966,409 tons; Bessemer, 15,415 tons; foundry and malleable, etc., 181,696 tons; low phosphorous iron (electric furnace), 30,425 tons. The 1917 production included: Basic, 961,656 tons; Bessemer, 14,092 tons; foundry and malleable, 181,041 tons; low phosphorous (electric furnace), 13,691 tons.

The old furnace plant at Midland was reconstructed and placed in operation during the year. The blast flame plants operated included those of the Dominion Iron and Steel Company at Sydney, N. S., the Nova Scotia Steel and Coal Company at North Sydney; the Standard Iron Company at Deseronto, Ont.; the Steel Company of Canada at Hamilton, Ontario, the Canadian Furnace Company at Port Colborne, Ont., the Algoma Steel Corporation, Ltd., at Sault Ste. Marie, Ont., and the Midland Iron and Steel Company at Midland.

Electric furnaces were operated for the production of pig-iron from scrap at Hull and Shawinigan Falls, Que., at Orillia, Collingwood, St. Catharines, Toronto, Belleville and Bowmanville, Ont., and at Port Moody, B. C.

The exports of pig-iron during 1918 were 2,130 tons valued at \$169,495, or an average of \$79.57 per ton, and of ferro-alloys 23,781 values at \$2,671,434, or an average of \$112.33 per ton. The imports during 1918 included 67,396 tons of pig-iron valued at \$2,102,406, or an average of \$31.19 per ton and 35,284 tons of ferro-alloys valued at \$4,283,133 or an average of \$121.39 per ton making a total import of pig-iron and ferro-alloys of 102,680 tons, valued at \$6,385,539.

Steel—The estimated production of steel ingots and direct steel castings in 1918, final returns for all operations not yet having been received, was 1,893,000 short tons, of which 1,820,000 tons were ingots and 73,000 tons direct steel castings. In 1917, the total production was 1,745,734 short tons of which 1,691,291 tons were ingots and 54,443 tons were castings.

The production of steel in electric furnaces in 1918 was about 120,000 tons as against 50,476 tons in 1917; 19,639 tons in 1916; 5,625 tons in 1915 and 61 tons in 1914.

The total production of pig-iron, ferro-alloys and steel in electric furnaces in 1918 was about 194,000.

The exports of steel during 1918, as per Customs Department records included: billets, blooms and ingots, 61,782 tons, valued at \$2,645,943, or an average of \$42.83 per ton; bars and rods 105,285 tons, valued at \$10,312,657, or an average of \$97.95 per ton; steel rails 12,952 tons, valued at \$575,062, or an average of \$44.40 per ton; wire and wire nails valued at \$6,294,195; scrap iron and steel 51,544 tons, valued at \$853,097, or an average of \$16.55 per ton, together with a large quantity of manufactured iron and steel goods.

The recorded imports of iron and steel ingots and billets during the year were 3,409 tons, valued at \$262,210. This item evidently does not include steel billets imported for the use of the Imperial Government. The United States trade record shows exports to Can-

ada during the same period of 247,332 gross tons, of billets, ingots and blooms of steel valued at \$19,787,779, an average of \$80 per gross ton.

Asbestos—The production of asbestos has increased very rapidly during the past four years, and average prices in 1918 were about three to four times those of 1914. As usual the production has all been derived from Black Lake, Thetford, Robertsonville, Coleraine, East Broughton and Danville in the Eastern Townships, Province of Quebec.

There was a falling off in 1918 of 1,955 tons in the output and 1,691.8 tons in the sales of crude asbestos, but an increase in average price of crude, from \$510.47 per ton in 1917, to \$671.35 in 1918. The shipments of mill stock were increased in 1918 by 7,660 tons and the average price was increased from \$34.08 in 1917 to \$46.87 in 1918.

The total value of the shipments of asbestos and asbestic in 1918 was \$8,970,779 as against \$7,230,383 in 1917.

Gypsum—Because of the general cessation of building activities during the war the production of gypsum has fallen in 1918 to less than one quarter the tonnage mined in 1913. The difficulties in securing boat transportation for shipments from the Maritime Provinces was a contributory cause of decreased output. The total quantity of gypsum rock quarried in 1918 was 155,298 tons, of which 88,748 tons were calcined. The shipments of all grades totalled 152,287 tons valued at \$823,006 and included lump gypsum 43,728 tons valued at \$47,727; crushed, 25,074 tons valued at \$55,079; fine ground, 4,558 tons valued at \$12,621, and calcined, 78,927 tons valued at \$707,579. By provinces the shipments were: Nova Scotia, 49,365 tons valued at \$115,976; New Brunswick, 27,225 tons valued at \$214,114; Ontario, 38,214 tons valued at \$151,564; Manitoba, 37,483 tons valued at \$341,352.

In 1917 the quantity quarried was 365,659 tons, of which 97,667 tons were calcined. The shipments included: Lump, 223,760 tons valued at \$246,774; crushed, 32,305 tons valued at \$51,869; fine ground, 4,843 tons valued at \$19,222, and calcined, 75,424 tons valued at \$564,119, or a total of 336,332 tons valued at \$881,984.

Cement—The total quantity of cement sold from Canadian cement mills in 1918 was 3,591,481 barrels valued at \$7,076,503, or an average of \$1.97 per barrel as compared with sales in 1917 of 4,768,488 barrels valued at \$7,724,246, or an average of \$1.62 per barrel, showing a decrease in quantity sold of 1,177,007 barrels, or 24.68 per cent, and a decrease in total value of \$647,743, or 8.38 per cent.

Sales of cement from mills in Quebec in 1918 were 1,564,360 barrels valued at \$3,003,571; in Ontario, 1,220,003 barrels valued at \$1,976,815, and from Manitoba, Alberta and British Columbia 807,118 barrels valued at \$2,096,117.

The total quantity of cement made in 1918 was 3,417,660 barrels as compared with 4,987,255 barrels made in 1917, a decrease of 1,569,595 barrels, or 31.47 per cent.

Stocks of cement on hand January 1, 1918, were 1,660,406 barrels and at the end of December had been reduced to 1,480,565 barrels.

The total imports of cement in 1918 were 20,695 cwt. equivalent to 5,913 barrels of 350 pounds each, valued at \$19,851, or an average of \$3.36 per barrel, as

compared with imports of 8,580 barrels valued at \$19,646, or an average of \$2.29 per barrel in 1917.

The total consumption of cement therefore, neglecting a small export was 3,603,414 barrels as compared with a consumption of 4,777,068 barrels in 1917, showing a decrease of 1,173,654 barrels, or 24.57 per cent.

Nickel—The total production of nickel in 1918 was 92,076,034 pounds, worth at 40 cents per pound \$36,830,414, as compared with 84,330,280 pounds valued at \$33,732,112 in 1917. This production is derived as usual, from the ores of the Sudbury district supplemented by the recovery of a small quantity of metallic nickel, nickel oxides and other nickel salts, as by-products in the treatment of silver-cobalt-nickel ores of the Cobalt district.

As in past years nickel was recovered as a by-product in the smelters of the Coniagas Reduction Company, Thorold, Ont., the Deloro Smelting and Refining Company, Deloro, Ont., and the Metals Chemical Company, Welland, Ont.

Zinc—Previous to 1916 all zinc ores mined in Canada were exported for both smelting and refining, but during the last three years much of the ore has been treated in Canada, following the establishment of the electrolytic zinc refinery at Trail, B. C., by the Consolidated Mining and Smelting Company. The production of refined zinc was 2,974 tons in 1916; 9,985 tons in 1917 and about 12,278 tons in 1918.

The total production of zinc during 1918 from Canadian ores—including in addition to the above refined production, the estimated recovery from ores exported (20 per cent allowed for smelter losses) amounted to 33,663,690 pounds, which at the average price of spelter in New York, 8.159 cents per pound, would have a total value of \$2,746,620, as against 29,668,764 pounds, valued at \$2,640,817, or an average value of 8.901 cents per pound in 1917.

Quebec in 1918 is credited with 2,652,526 pounds, and British Columbia with 31,011,164 pounds.

Coal—The production of marketable coal during 1918 was, with the exception of the year 1913, the largest on record for any one year. The tables herewith show the output and production for 1917 and 1918 by provinces, and the imports for the same years:

Output¹ and Production² of Coal, 1917 and 1918.
(In short tons).

	1917.				1918.			
	Output.	Production.	Value of production.	Ave. per ton.	Output.	Production.	Value of production.	Ave. per ton.
			\$	¢			\$	¢
Nova Scotia	6,345,335	6,327,091	19,410,737	3 068	5,838,530	5,852,803	21,551,551	3 68
New Brunswick	189,668	189,095	708,010	3 744	268,205	267,746	1,317,278	4 92
Saskatchewan	360,623	355,449	662,451	1 86	347,622	345,310	708,192	2 06
Alberta	4,673,637	4,736,368	14,163,685	2 99	6,070,888	5,911,864	20,822,418	3 50
British Columbia	1,860,894	2,433,898	8,235,716	3 383	2,878,102	2,564,591	11,341,632	4 42
Yukon Territory	5,284	4,872	29,232	6 00	11,939	2,900	11,600	4 00
Total	14,435,361	14,046,759	43,199,831	3 08	16,405,958	14,979,213	55,782,671	3 72

¹ Output includes waste and unmarketable slack. ² Production includes sales, colliery consumption, and coal used by operators in making coke, or for other uses.

Imports of Coal.

	1917.			1918.		
	Tons.	Value.	Average	Tons.	Value.	Average
Bituminous, round and run of mine	12,407,496	\$13,712,884	\$2 72	13,656,366	\$37,291,057	\$2 73
Bituminous slack	3,129,776	8,739,877	2 79	3,237,095	8,351,829	2 58
Anthracite coal and dust	5,320,198	28,109,586	5 28	4,780,160	26,007,898	5 44
Total	20,857,460	70,562,337	3 38	21,673,621	71,650,784	3 30

The Motor Truck and Our Highways

By Lucius E. Allen*

A CAREFUL study of the evolution of our highways, especially during the last ten years, is of more than passing importance, but there is one feature in this connection—the motor truck traffic—which may well bear our investigation and consideration.

The relation of the motor truck to that of our highways should not be considered in any narrow sense, but should be treated from the standpoint of present day demands of trade, commerce and the best interests of the general public. As community-connecting highways are necessary functions of the state in order to provide means of easy accommodation from one community to another at a minimum expenditure of time and money, it may be considered that the state must lay down certain well-defined regulations as to the traffic allowed on our public highways so as to best conserve our highways for public use.

Motor Truck Traffic Not Foreseen

It must be admitted that those responsible for the construction of our highways ten years ago had no reason to believe that they would be so extensively used by motor trucks, so that as road builders are neither prophets or sons of prophets, any faults which may now exist in our main highways in their relation to motor truck traffic should not be laid at their door. Without doubt, the great war just ended has been largely responsible for the remarkable growth of the motor truck industry, and their general use on our highways. It is now a historical fact that the rapidity with which British and French troops were conveyed to the front during the early stages of the war on the Western front, was largely responsible for the stopping of the German drive on Paris. But the everyday use of the motor transport in carrying provisions and munitions, over the network of roads available, where railroad communication was impossible, has demonstrated beyond question the utility of the motor truck as a means of transportation.

Rapid Development of Use of Motor Truck

Some idea of the rapid development of the use of motor trucks may be gained by a glance at the accompanying chart of motor truck output in the United States from 1910 to 1919.

It will be seen that in 1910 there was produced 9,500 motor trucks. By 1914 the production had risen to 35,000 and the succeeding four years indicate the remarkable growth of the motor truck industry:—1915—74,000; 1916—98,000; 1917, 190,000; 1918—250,000. These figures do not include the thousands of used motor cars that were converted into light trucks and delivery vans. The increased use of the motor truck in Canada during the past few years has also shown remarkable advancement, and with the development of our main highways will continue to grow more general.

As members of this association we are vitally interested in the development and maintenance of good roads throughout the Province, and we are, therefore, in a position to consider the very important question of the effect of motor truck traffic on our highways

from all view points, and should, so far as possible, endeavor to work out the various problems connected with this traffic to the best interests of all concerned with questions of transportation.

Regulation of Motor Truck Traffic

It cannot be denied that the motor truck has the right to use our highways but in order to protect and conserve the roads already constructed there should

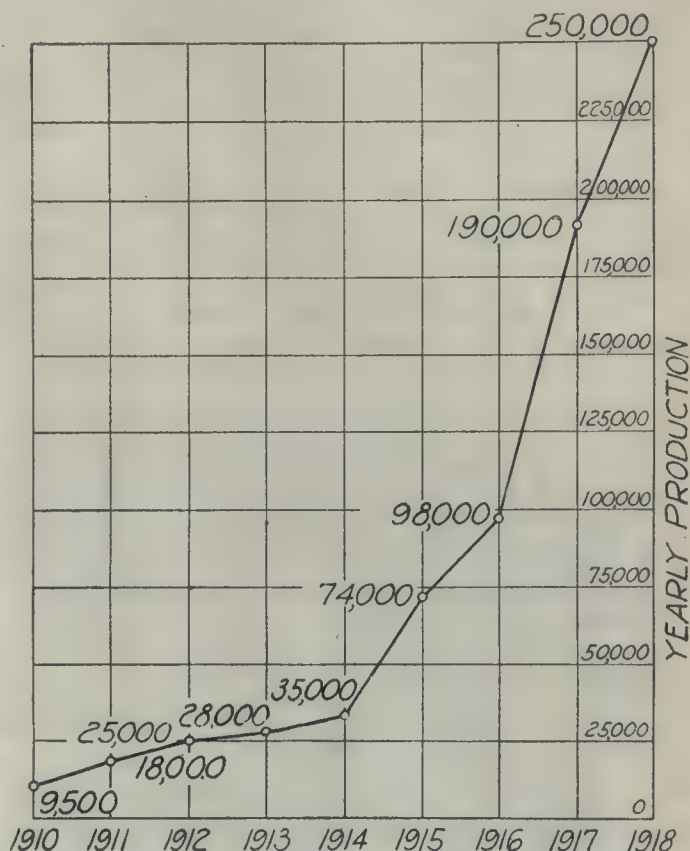


Chart showing rapid advance in production of motor trucks in the U. S.

be some reasonable regulation as to weight of truck. It has not been many years that a sixty-pound rail was considered a standard weight of rail for our railroads, and with the light locomotives then in use, the sixty-pound rail was amply sufficient to withstand the traffic, but with the present day traffic no main line railroad would be laid with less than a ninety or one hundred and ten pound rail.

Comparatively speaking a five-ton truck is as much out of place on a roadway constructed for light traffic as a heavy locomotive would be operating on a sixty-pound rail, and while the road would, under ordinary conditions of traffic, sustain the heavy load, its continued use would, in a short time, destroy the road surface. On the other hand we must carefully consider whether it is in the best interests of the country as a whole to discourage the use of motor trucks on our highways by placing restrictive regulations on their operation over the roads of the country. It must be conceded that the motor truck has found a place in the transportation system of the country at large. It affords a quick and economical method of

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transporting the produce raised on the farm to town and city markets previously not available. Communities not conveniently reached by railroads can deliver and receive goods at a nominal cost of time and money.

Speed Regulations.

Regulations as to speed of motor trucks should also be considered, although from the standpoint of danger to traffic it is not so necessary as in the case of pleasure cars, or light capacity delivery cars. It has been observed that on some main truck routes, heavily loaded trucks, as a rule, give very little right of way to passing traffic. Where the highway is too narrow this may be a source of danger and for this reason, on main trunk roads that will be extensively used by motor trucks, the width of the road should be carefully considered. The width of bridges should also be taken into account and should be constructed to take care of future requirements in traffic. While a sixteen foot roadway on a bridge located on many rural roads is sufficient for all ordinary traffic, on a main highway, the width at very little additional cost of construction could be increased to twenty or twenty-four feet, which would provide for all contingencies of heavy traffic.

Adaptation of Type of Road.

In considering the construction or reconstruction of a main trunk highway which it is known will be used by all classes of traffic, including heavy motor trucks, there are many conditions which must be carefully considered, and one of the most important is the selection of the type of road which will best suit the traffic which will be placed upon it. Time will not permit of a discussion in detail of the various types of roads adapted for heavy traffic, but there are a few general conclusions which may be mentioned, that have been drawn from actual results in the past four years.

Trucks Used to Relieve Railway

Some of these results may be considered to be abnormal, due to the congestion of all classes of transportation due to war conditions, but in any case they will indicate the present day maximum depends upon our highways. Owing to the great tonnage of all kinds of war materials which were required at seaboard railway traffic became extremely congested, especially in the Eastern portion of the United States, so much so that as a last resort, large capacity motor trucks were resorted to as some relief to the railways. Regular trips of motor truck trains were made, covering distances of from 100 to 1,500 miles. The advantages of this mode of transportation became apparent as the goods carried were delivered more promptly and with greater certainty than by any other means of transportation then available. Road routes were selected that would provide the most direct line over the best roads then available. This traffic soon assumed large proportions and has now led to the formation of well established motor truck transportation systems in many parts of the country.

Cheaper Types of Roads Failed

The effect of this sudden increase of heavy motor truck traffic upon the various types of roads soon became visible to all highway officials and those interested in good roads. Many sections of roadway, with poor foundation and insufficient surfacing, soon commenced to go to pieces under the heavy traffic, and in a short time were almost completely destroyed,

while sections properly constructed of the right kind of materials adapted for heavy traffic withstood the traffic with little wear or damage to the road surface.

It was found that some of the cheaper types of roads in point of first cost, became the most expensive in the long run, as the cost of maintenance became extremely heavy. Generally speaking those roads constructed with a hard impervious surface, such as brick, concrete or asphaltic concrete gave the best results. Ordinary water-bound macadam, in many cases, did not stand up under the heavy traffic.

A Severe Test

While it must be admitted that the results of this heavy traffic was, perhaps, in many cases abnormal, yet it is only fair to conclude that though the test was a severe one, that many valuable conclusions may be drawn from these results which should be taken into consideration when building new roads.

Reasonable time should be given for rebuilding a road surface suitable for heavy motor traffic before heavy trucking is allowed to go on the road, otherwise much damage will be done. With the proposed construction of the main Provincial highway it is quite conceivable that it will be extensively used for motor trucking. An extensive transportation system is being built up over the Toronto-Hamilton Highway for motor trucks, and there is every reason to believe that similar conditions will follow both East and West of Toronto and other towns and cities along the route of the provincial highway. No better method of food administration as between the producer on the farm and the consumer in the city can be provided than by motor trucking. The carrying of milk, vegetables and farm produce, including the delivery of beef cattle and hogs from farm to stock-yard are all features of motor trucking that have already been demonstrated to be both practicable and economical, and with the advent of good roads will more and more become general throughout the country.

In conclusion it may be stated that the problem of the motor truck, in its relation to good roads, is one of selection rather than elimination. The motor truck has come and will remain with us in increasing numbers, and will help to solve the question of the high cost of living. The building of good roads has become a necessity and it is only by the co-relation of good roads built to suit conditions as they are and will be in the future, that the best results to the greatest number of people can be secured.

Members of the Engineering Institute of Canada and other engineers resident in the Niagara district met in Niagara Falls, Ont., on March 11th, and formed a "Niagara Peninsula" branch of the Institute. The general secretary, Frazer S. Keith, explained the scope and functions of the Engineering Institute to a large and representative gathering from St. Catharines, Thorold and Niagara Falls. Visiting engineers were present from New York City, Philadelphia, Niagara Falls, N.Y., and from the Hamilton Branch. The Niagara Peninsula branch was launched with enthusiastic scenes and with an initial membership of nearly thirty. The following officers were elected: Chairman—A. C. D. Blanchard, M.E.I.C., Niagara Falls, Ont.; vice-chairman, W. P. Near, A.M.E.I.C., St. Catharines, Ont.; secretary-treasurer, R. P. Johnson, S.M.E.I.C., Niagara Falls, Ont.



From left to right, A. J. Armstrong, Supt. Dominion Construction Co.; C. Bentall, Manager Dominion Construction Co.; Mr. Eckhart, Electrician; G. W. Revell, Timekeeper; Mr. Muirhead, B. C. Electrical Inspector; Jas. Gill, Inspector of Works; J. J. McMinn, Mech. Eng. of Soldiers' Civil Re-establishment; Mr. Chamberlain, of Mundy-Rowland Co., Enlarging Tranquille Sanitarium.

Enlarging Tranquille Sanitarium

AT Tranquille, B. C., a small settlement ten miles west of Kamloops on the Canadian National Railway, there has been for the past seven or eight years a sanitarium for the care and cure of those of our fellow-men who have become victims of the Great White Plague. This sanitarium, the King Edward, has been doing very fine work in treating tubercular cases. Tranquille is situated in the high dry belt of British Columbia, and the climatic conditions are ideal for the object in mind.

Present Building Overtaxed

Owing to the heavy demand for beds in the already overtaxed hospital by civilians in addition to the number of returned soldier cases, the British Columbia branch of the Anti-Tuberculosis Society, in conjunction with the provincial and federal governments, came to the conclusion that a waiting list of consumptives should not exist. The result was seen in the awarding of a contract to the Dominion Construction Co., Ltd., of Vancouver, for the erection of an infirmary and service building. The contract was let at approximately \$150,000, the two governments sharing the expense. As soon as the soldier cases have all been evacuated the entire building will be used for civilians.

The contract is for the construction of a two-storey infirmary building 45 x 100 ft., with wings at each end of the same size, altogether having a capacity of 130 patients, and a service building 70 x 130 ft. The exteriors will be of red ruberoid and red asbestos shingles; that of the service building of tar and gravel.

Sub Contracts

The sub-contracts were let as follows: Plumbing and heating, Orr Bros., Vancouver; electrical work, Mundy, Rowland Co., Ltd., Vancouver; lathing and plastering, Messrs. Rush & Read, Vancouver; painting, Kunekin Bros., Vancouver; sheet metal work, Pacific Sheet Metal Co., Ltd., Vancouver; interior trim and woodworking, Jas. Brookes Woodworking Co., Ltd., New Westminster.

Work Proceeded Throughout Winter

Excavating for the two buildings was commenced on October 1st of last year. For this job a clam-shell, with teeth, capacity one-and-a-half yards per grab, which had previously been used for dredging in salt water at Vancouver, was utilized. This was found to

be economical and greatly speeded up the excavating. Though the work has been going on in mid-winter it will be seen from the accompanying illustration that the infirmary is erected and the roof in place. All the sash is now on the ground and the largest of it is installed.

The contract calls for the work to be finished by July 1st, and with the good start already made Mana-



Upper—New section of Sanitarium at Tranquille under construction
Lower—Present Sanitarium Buildings being duplicated.

ger Bentall, of the Dominion Construction Co., Ltd., is confident that the work will be finished well within the time limit set.

The Toronto Board of Trade has been advised that the Ninth Congress of the British Imperial Council of Commerce will be held in Toronto, September, 1920.

The holding of this Congress will be the most notable trade meeting ever held in Canada. Matters affecting the commercial welfare of the Empire will be discussed and the proceedings will be noteworthy and far-reaching in every respect.

This will be the second time Canada has been honored with a meeting of this organization, and it will be presided over by the Right Honorable Lord Desborough, K.C.V.O. The last meeting was held in Montreal in 1903, and was presided over by Lord Brassey.

Lower Wages Not Necessary to Resumption of Building

THAT a reduced wage scale is not an indispensable preliminary to resumption of activity in the building trades is the opinion of Morton Chase Tuttle, who has just returned to Boston after more than a year of service as production manager for the United States Emergency Fleet Corporation. Mr. Tuttle bases his judgment on some very recent investigations of large construction enterprises located at various points from New England to Florida, supplemented by careful studies carried out under his direction by the Aberthaw Construction Company of Boston, of which he is General Manager. These unmistakably indicate that increased efficiency of labor is bringing down costs even while wages remain at existing altitudes.

In the course of viewing numerous undertakings more or less closely associated with interests of the Government," says Mr. Tuttle, "I have lately been impressed to find the statement commonly made that costs of operation are beginning to show a noticeable decline. And this, almost without exception, was attributed to increased efficiency of the labor force, due in part to the opportunity for weeding out the less dependable workers, in part to the growing desire of all members of the force to retain their jobs.

"Owing to the inadequate or otherwise unsatisfactory cost system maintained in connection with most of these undertakings, I found it impossible fully to check the statement by actual figures. Accordingly, I asked my own company to make out the cost of any one process in an operation continued over a period of several weeks. That which was selected was a piece of concrete work; the costs studied were those for the common labor employed on this work from January 7th to February 4th of the present year inclusive. During this period the wage scale remained unaltered; but the personnel of the labor force underwent frequent changes.

"A graph of the labor cost of the work during the period noted shows a sharp and almost undeviating decline from day to day. On February 4th these costs were exactly 50 per cent. less per unit than were those of January 7th. It is my belief that the experience of my company is by no means isolated; and that in almost any labor force there lies the opportunity of realizing economies ranging from 20 to 50 per cent. without interfering with the wage scale.

"This implies, of course, that there is now increased opportunity for selecting men according to their suitability for a given task, and an increased eagerness on the part of the men to make good. But this is as it should be; and the whole country ought soon to feel the effect of it in general improvement at all points. It is a case of supplanting so called liquidation of labor by proper adaptation of labor as a means of keeping the cost of doing things within the bounds of utility.

"And in this connection it may well be urged that state of mind is often as potent a factor in ultimate labor costs as is the rate per hour. Any one experienced in handling workmen has recognized the difference in output between a cheerful, capable man, anxious to hold his place, and one who is a little disgruntled,

and quite conscious that he can get another job the moment he drops the present one. Multiply either case by thousands of individual instances and I believe that there will be found, in shifts of mental attitude, the explanation of much of the variation which occurs in unit cost. And this, after all, is the element of labor which directly affects the profits of the employer."

New Building Material Easily Handled*

THE stagnation in the building trade, due to four years of war, has produced a local and a world-wide shortage in the supply of dwelling houses. Added to this the war has produced a scarcity in many lines of building material.

Every community is preparing to co-operate with our governments in their housing schemes, in order that our quickened industrial activities may tend to restore normal conditions as our soldiers return from abroad.

To-day we face a condition that threatens to affect the success of our plans; for our building program, if carried out upon the old lines, will quickly deplete the stores of lumber and other material on hand.

The competition between export demands and the domestic market tends towards prices that will either diminish our export trade or make our building program so costly as to defeat the end we have in view, which is dwelling houses at a moderate cost, without checking our export trade. Under such conditions let us follow the example set us by our armies in France, who, under the stress of war, cut out red tape, adopted methods that enabled them to press into their service every available product of earth and sky, to attain success.

The Alabastine Company, The Ontario Gypsum Company, and The Canada Plaster Board Company, advocate the building of homes that are not so liable to loss by fire as the average Canadian home of to-day. We would have them durable, fire-proof and beautiful; cooler in summer and warmer in winter; and by the introduction of material from our Canadian mines, which is available in unlimited quantities, we would prevent an advance in the cost of construction.

The Ontario Gypsum Company of Paris, Ontario, have erected, opposite their office, in Paris, a pair of houses, into which all the improvements have been introduced. They call them gypsum houses. The walls are of gypsum blocks, cast from gypsum mortar, in the form of a double wall, the outside being of 3 inch blocks, and the inside of 4 inch blocks, with one inch air space between. Each course is tied with wire wall ties at 3 ft. intervals; joints are broken as in brick construction.

The blocks are all cast 24 inches long and 12 inches wide, being cut with an ordinary saw when necessary. The blocks are cast solid and are made on the premises. Any one who has ever made mud pies can make gypsum blocks. So much gypsum and so much water are stirred together and poured into a mould. By the time five have been mixed and pour-

*Abstract of an address by Mr. John H. Gale, before Ontario Hardware Association.

ed, the first is set and ready to be taken from the mould and set out to dry.

Owing to the porous character of the gypsum it is necessary to provide for absolute waterproofing of the entire exterior wall surface. This is provided for in several ways, differing according to the character of the building. The pair of houses are semi-detached, with the dividing walls of gypsum blocks. The ceilings are plaster board, nailed to the floor and ceiling joists. This is manufactured by the Canada Plaster Board Company, an associate company, whose factory adjoins the plant of the Ontario Gypsum Company at Caledonia.

The plastering throughout is with Gypsum Hard-wall Plaster, applied directly upon the blocks or plaster board. The partitions are of plaster board, nailed to wood studs; no lath or furring is used in the houses. Plaster board is made in sheets or boards 32 x 36 inches (8 sq. ft.). It consists of a filling of plaster paris 3/8 inch thick between two sheets of paper.

These boards cost 30 per cent. less than the inflammable board made of wood pulp that are now on the market. Plaster board takes the place of wood lath and of one coat of plaster. These boards are as easily cut with a saw or nailed in place as pine boards would be. The foundation walls of the houses are of concrete, which is made waterproof by the addition of ten per cent. Elora hydrated lime.

The cost is somewhat less than a dwelling built with a brick veneer of the usual construction with wood sheeting, and lath and plaster walls. We would have this wood sold abroad, and the walls made fire-proof.

Outer walls may be constructed with an exterior brick veneer, tied to gypsum blocks, three to four inches thick, built with the usual one inch air space. Such a wall will be at once durable, strong and fire-proof, and will not cost more than ordinary walls without these advantages. Abstracts of an address by Mr. John H. Colé before the convention of the Ontario Retail Hardware Association.

Mainly Constructional

East and West—From Coast to Coast

The Southern Canada Power Company's dam across the St. Francis River has been completed.

The fire loss for the month of February in Toronto is estimated at \$64,054 as compared with \$160,471 for the same month in 1918.

The aqueduct from Shoal Lake to Winnipeg has been completely connected up and water will be delivered to the domestic services of the citizens by April 1st.

The Ottawa Board of Control recommend to council that a competent architect be permanently engaged to take full charge of building inspection and civic building work.

The Harbor and Marine Co., Ltd., is being organized at Victoria, B. C., and is laying down a plant for the construction of two 8,100-ton steel steamships for the Dominion Government.

The convention of trades unions at Halifax, N. S., recently passed a resolution favoring a 44-hour week. They also resolved that women doing similar work to men should receive the same pay.

In February, 1919, there were 20 building permits issued in the city of Quebec at a value of \$53,630, as compared with an equal number of permits at a value of only \$25,147, in the same month last year.

Many interested in the University of British Columbia are agitating for additional accommodation and urging that it be transferred from Vancouver, B. C., to permanent buildings at the Point Grey site.

The Continental Oil Co. has taken an option on a 40-acre site at Regina, Sask., and proposes to erect a refining plant at a cost of \$1,000,000. Crude oil will be brought in from the Wyoming oil fields.

A petition is being presented to the Ontario Government by the municipalities along the route of the Toronto-Hamilton Highway requesting that this road be taken over as a part of the Provincial Highway.

The total amount of loss by fire in Pembroke, Ont., during 1918 was \$1,086,481, on which the total amount of insurance paid for the year was \$893,786. This is the greatest loss Pembroke has ever had in any one year.

Chatham's building permits for the month of February total the sum of \$8,100, an increase of \$5,225 over the same month last year. The total for the two months of this year is \$11,900, as against \$3,085 for the same period of 1918.

Toronto civic officials are considering a housing scheme, and having appointed a committee to make enquiries as to the advisability of forming a co-partnership housing company and to ascertain whether the government's loan will be available under this plan.

The Stanley Board of Trade urge that the York & Carleton Ry. be extended to connect with the Canadian National Railway's Transcontinental line at Napudogan, and thus give a route to St. John 11 miles shorter than the proposed route, via McGivney Junction.

The Canadian Mining Institute will urge upon the Federal and Provincial Governments the necessity of giving a better scale of wages to the technical workers in government departments. This action was decided upon at their recent convention held at Montreal.

It is understood that the C. P. R. will spend considerable money in terminal improvements at Fort William, Ont., this year. One of the principal items on the programme is the paving of the large stock yards with concrete, and the placing of new ties and steel in different parts of the yards.

The Imperial Munitions Board has recently completed its contract for the building and outfitting of 27 wooden steamers in British Columbia. The work, from the laying of the keels to the final trials, has been finished in twenty months, a record which officials state has not been equalled on this continent.

A delegation from Iroquois Falls, Ont., recently presented a petition to the provincial highways departments for the construction of three roads, one from Iroquois Falls to the Governmental Farm at Monteith, a second one to Cochrane, a distance of 39 miles, and a third one from Iroquois Falls to South Porcupine, 25 miles.

Sir Adam Beck has announced that work will be commenced on the Toronto to London Radial Railway as soon as the legislation which has prohibited such construction during the war, is rescinded. Bonds are to be issued to cover the cost of the work, which has already been authorized by vote of the municipalities concerned.

The provincial government has promised substantial financial aid towards the construction of a bridge connecting Allumette Island, in the Ottawa River, with the mainland at Waltham, P. Q. Federal aid has also been assured, and en-

gineers under the direction of the Minister of Public Works have made surveys and reported favorably.

The Nova Scotia Provincial Executive of the G. W. V. A. has passed a resolution requesting the formation of a federal or provincial commission, on the lines of the Halifax Relief Commission, to administer all housing funds voted by either the Dominion or provincial government. They are opposed to allowing this work to be carried on by municipalities or private companies.

The plans for the proposed new medical building for the Western University at London, Ont., drawn by Watt & Blackwell, have been approved by the special building committee of the board of governors of the University. The city has voted \$100,000 towards the erection of the building and the Ontario Government will be asked for a grant of \$150,000. The site is at the corner of Ottawa Ave. and Waterloo Street.

The Board of Works employees in Galt, Ont., have been granted an increase in wages. The new scale is 28c to 39c an hour, an increase of 3c over the old scale, which was 25c to 36c. The men will have the privilege of working nine or ten hours a day at the new rate of wages. The Public Utilities Commission have agreed that the waterworks employees should receive the same rate as the Board of Works men.

A motion was recently brought up in the Quebec Legislature requesting that the Montreal-Hull road be established as a provincial highway. Hon. J. A. Tessier, Minister of Roads, said the government was strongly in favor of this project and the surveys and estimates that had been promised had been completed. The work would be vigorously proceeded with during the coming season.

At a recent special meeting of the Winnipeg Trades and Labor Council, called for the purpose of instructing delegates to the Western Labor Convention, the following resolution was passed with practically a unanimous vote: "This Winnipeg Trades and Labor Council stands opposed to any effort being made to reintroduce the drink traffic." One of two members spoke against the motion, but when the vote was taken there was not a hand held up against it.

The Imperial Oil Company has recently purchased two blocks of lands in Eastview, Regina, having in view the extension of their housing scheme for their employees. This property adjoins the block of residences constructed last year on the east side of Laird and Young streets. It is understood that the plan is to construct on one of the newly-acquired blocks of land thirty houses, leaving, in the centre, a site for the erection of a hall to be used for social and recreation purposes.

The Canadian Trade Commission has issued invitations to manufacturers to attend conferences at Ottawa for the purpose of forming groups through which information secured by the commission may be communicated to the trades. Much of the business to be secured at the present time in Europe is of an urgent character and it has been found necessary to organize in the manner indicated so that information coming to the commission may be made immediately available to all concerned.

In the Quebec Legislature recently, the question was brought up regarding the necessity for a bridge between St. Anne de Bellevue and Ile Perrot and between Ile Perrot and Vaudreuil. Hon. L. A. Taschereau declared that the government was quite interested in the matter and felt that the bridge should be built across the islands connecting St. Anne with Vaudreuil but while they were prepared to pay a generous part of the cost which would be about \$300,000, and the Federal Government was ready to do something, he thought the municipalities should also bear a share and that they should come forward with a definite proposal.

Personals

Mr. Percy West, a returned soldier, has been appointed building inspector for St. Catharines, Ont.

Mr. D. T. Black, who for eight years has been city engineer of Welland, Ont., has now been appointed city engineer of Niagara Falls, succeeding the late Mr. Fred Anderson, who was killed in battle.

Major-General J. W. Stewart, of the firm of Foley Bros. Welch & Stewart, railway contractors, Vancouver, has returned to Canada from the front, where he was in charge of railway construction from 1916. He states that during the period he was in charge 3000 miles of broad gauge and 6000 miles of narrow gauge railways were constructed.

Mr. W. G. Yorston, C.E., has resigned as chief engineer of the Nova Scotia Highways Board, but has consented to act as consulting engineer for the balance of the present year. He has not been in very good health, and it is for this reason he is giving up the position. In accepting his resignation, the highways board passed a resolution expressing their appreciation of Mr. Yorston's services and their regret that he could no longer act in the capacity of chief engineer.

Mr. A. S. Clarkson, C.E., of Montreal, has been appointed general secretary and organizer of the Association of Canadian Building and Construction Industries. There were a very large number of applications for the position. Mr. Clarkson, who will open an office for the association in Ottawa, is an Englishman by birth. He has had many years' engineering experience in Great Britain, the U. S. and Can-



Mr. A. S. Clarkson, General Secretary A. C. B. & C. I.

ada, having come to this country nearly ten years ago. He was at one time on the staff of the Montreal Electrical Commission, and was later appointed city engineer of Verdun, from which he recently resigned. He is a Fellow of the Royal Colonial Institute of London, England; associate member of the Engineering Institute of Canada, and a member of the American Road Builders' Association.

Obituary

Mr. W. F. Lee, who was well known as a contractor in Winnipeg in the early days, died recently in California.

Mr. Louis Andre Valles, chief engineer and director of railways, Public Works and Labour Department, Province of Quebec, died on March 10th at Quebec, after a long illness, aged 67. Mr. Vallee was also engineer of the Quebec Public Utilities Commission.

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Legislation or a Code of Ethics, Which Is Needed Most?

THERE is a considerable discussion going on at present among the members of the Engineering Institute of Canada regarding the efficacy of "Legislation" in removing the present ills of the profession. Particularly it is argued that by licensing engineers we should succeed in raising the standards of remuneration. Now the writer is of an entirely open mind on the subject of legislation, but, at the same time, makes bold to confess that he cannot see how either the status of engineering or the remuneration of engineers can be improved by this course, unless, indeed, it is proposed to exclude from the privilege of practising all those engineers who at the present time are guilty of unethical conduct, or are responsible, directly or indirectly, for reducing the rates of remuneration. In that case, however, the membership of the engineering profession might be too severely decimated.

A case in point: A contract is to be let for the design and construction of a large bridge. Four or five of our best-known firms enter the competition. The announcement is made that the contract is let to one of

them. This, however, does not settle the matter so far as the other firms are concerned. They continue to discuss the matter with members of the municipal council, they submit new plans and endeavor in various and devious ways to upset the original contract. Certain of them seek to discredit their competitors—their brother engineers.

Could anything be more unprofessional? Could the council and citizens of that municipality do otherwise than conclude that engineers, in general, are a body of men for whom it would be a waste of energy to entertain respect? In what way will legislation remedy this condition?

And there is still more to this case. The bridge will cost, it is said, in the neighborhood of \$300,000—certainly not less. A fair fee for designing and inspection would seem to be somewhere around 5 per cent—i.e. \$15,000. However, the cut-throat competition among these four or five brother engineering firms (who so urgently desire legislation to raise the standard of remuneration) has reduced this figure, we have been advised, to \$4,000.

Now what amount of legislation will ever rectify the condition existing in this case. These firms are working against one another. Each is suspicious and unfriendly towards the others. As a matter of fact, they are all merely playthings of the municipal council. If the councillors and mayor have any sense of humor they are enjoying as well as profiting by this auctioneering process of selling their services, practised by the engineers.

In all possible seriousness, we suggest that the members of the E. I. C. who hope to improve working conditions for themselves by legislation, while the ablest and best-known men in the profession are engaged in secretly auctioning their services, are doomed to disappointment. It reminds one very forcibly of that story about trying to take the mote out of our brother's eye. Until engineer's respect themselves no one else is going to be foolish enough to respect them.

Labor in Need of Guidance

THE City Council of Toronto has gone on record as favoring an 8-hour day and it is likely this will become the standard in all departments in the near future. The tendency everywhere seems to be toward shorter-hour days and the demands of labor in certain cases are becoming unreasonable. The question naturally arises—where is it going to end?

It seems that, temporarily at least, labor has become intoxicated with the idea that might is right. More than ever they feel the power of numbers. Nor can the fair-minded observer fail to realize that capital has more or less brought this condition on itself by pursuing the identical policy that it now condemns in labor. No one denies that capital has been arbitrary and unfair with labor in the past.

The problem today is to bring these two opposing forces into harmony and, to accomplish that, both sides must be reasonable. At the moment, however, it is "labor" that seems to be most in need of thoughtful guidance—both for their own sakes and that of the country at large. Capital can withdraw from the fields much easier than labor can, and in doing so may leave the latter stranded and the industrial progress of the country at a standstill. The attitude of labor during the next year or two in Canada may well determine

very largely the extent of our development for the next half century. We are just entering the race today and if we get off to a bad start it means losing the race or, perhaps, dropping out altogether.

There is one idea that labor seems to have omitted from its programme, and that must surely be included, viz:—value for wage received—a day's work for a day's wage. Nobody really cares whether this value is delivered over ten hours or nine hours or eight hours or over any other period. Labor makes the mistake, yet, of thinking in "hours" rather than in "service." The basis of trades' unions, for example, is a standard wage for a standard day; all men have the same value. It is not necessary to point out the utter inconsistency of this contention. It is as if one purchased sugar from his grocer on a time basis—a dollar for what the grocer could weigh out in ten minutes. One need only watch the average laborer on the street, or on ordinary building construction work to see that his ideal is wrong. The basis of all his computations is time—hours. He does not think of the quantity of work—except, indeed, to watch that no one exceeds a certain maximum, which is today much less than formerly constituted a day's work. He does not think of the "quality" of the service he renders. These things are largely responsible for the attitude of capital, though, very possibly, they do not entirely justify that attitude.

The labor problem will be with us for some time and can only be solved in one way. The labor man must admit his obligation to give fair value for wage received. The employer must admit his obligation to give fair wage for value received.

The Future of Structural Steel Work

ONE of the dominant factors in determining the immediate future of structural steelwork will be the cost of steel and its consequent relative scarcity. Many prophets have stated that the price of steel will rise as soon as the control is removed. We are to doubt it, or rather to doubt that the rise will be maintained for an appreciable period. There will undoubtedly be great demands for steel, but the possible output is very much in excess of pre-war figures. It is, however, difficult to prophesy with accuracy when conditions receive a violent change.

In any case, the cost of material is going to be a serious matter, and it will be much more necessary than formerly to consider economy in steel construction. We have repeatedly pointed out in these columns that current practice and regulations call for much waste in steel, and that careful designing can save thirty per cent of material without affecting the factor of safety of the structure as a whole.

The other direction in which progress can (and we think should) be made is in the use of steel with higher tensile strength. Many engineers seem to think that all high tensile steel is unsafe in structural work, because it is brittle; this is absolutely untrue. High tensile steel may be brittle, but it need not be, and it requires only reasonable care in testing and inspection to ensure that a high tensile steel shall be just as good as regards ductility as ordinary mild steel.

It is, for instance, easily possible to obtain a steel with a 23 ton yield point, which will pass all reasonable specifications with reference to ductility. This steel can safely be stressed to one and a half times as much as ordinary mild steel; if, therefore, it can be produced at a price which is less than one and a half

times that of ordinary mild steel, it will be economical to use it. We certainly believe that it can, but it will not of course, unless there is a good demand for it.

Housing and the Land

EVERY acre of land in Canada, agricultural, mineral or forest, now being held by private interests, should be valued. A fair price should be put on it and every owner should be taxed on that value.

The various housing schemes throughout the country are badly handicapped by the lack of land available at a price to meet the requirements of low priced homes.

There is a great deal of land that would be suitable for housing plans, but the owners find it more profitable to hold it in idleness while it grows in value with the growth of the population, than to put it to a useful purpose.

If this vacant land could be suitably taxed it would compel the owners to either utilize it or to dispose of it to someone who would utilize it. It would appear that a tax of this kind would remove one of the chief obstacles to the success of plans for cheap houses for workingmen.

A solution of the problem would be for the government to amend the Assessment Act, permitting the municipalities to exempt improvements or, as an alternative, assess all lands at one hundred cents on the dollar and improvements at, say, fifty cents on the dollar. The increase in the land assessment would more than offset the amount of exemption and in this way would make possible a reduction in the tax rate.

As the Assessment Act now stands, it practically penalizes the builder of houses. It appears to be impossible for the Housing Commission or anyone else to build and dispose of houses at prices the workingmen can pay, if they are compelled to pay the present price demanded for the land.

Convention of Clayworkers

The annual convention of the Canadian National Clay Products Association will be held in the Builders' Exchange rooms, Toronto, Ont., on Monday, Tuesday and Wednesday, May 26, 27 and 28. An excellent programme has been prepared, which will include the following papers:

Why Freight Rates are as They are and How Made, by Jas. E. Walsh, General Manager of the C. M. A.; Transportation of Clay Products, by Millard F. Gibson, general manager of the National Fireproofing Co.; Use of Firebrick in the Steel and Clay Products Business; Sewer Pipe Investigations, by A. G. Dalzell; Railroad Kilns, by Walter S. Kuffer of the American Dressler Tunnel Kilns Co.; Steam Shovel Comparisons, by Wm. Burgess, superintendent of the Don Valley Brick Works; Motor Trucks in the Clay Products Business, by Chas. Harrison and Horace Harpham.

It is also expected that Joseph Keele, chief engineer of the Ceramic Department, Mines Branch, Ottawa, will contribute a paper, and C. H. Hallatt, chairman of the Tile Committee, and M. F. Gibson, chairman of the Technical Education Committee, will give their report.

The social features are being looked after by the Montreal Convention Committee, of which L. W. McArthur is chairman.

Concrete Arch Bridges in Canada

An Historical Review of Canadian Bridge Building and Reference List of Reinforced Concrete Arch Spans

THE history of bridge building in Canada is a story of evolution from the almost purely utilitarian to that higher type of national structure which represents at the same time both artistic beauty of design and a characteristic ruggedness in construction. This change has been brought about to a considerable extent by the introduction of concrete, which has made it possible to introduce an almost infinite variety—the true basis of art.

And so it was an interesting address Mr. Frank Barber gave the members of the Toronto Section of the E. I. C. at their recent meeting when he described the development of bridge building in Canada, speaking more particularly of concrete structures. Mr. Barber had been at infinite pains to collect accurate data and even considered purely as a reference the paper was exceedingly valuable. It is for this purpose we reproduce the facts contained in the address. So far as we know it is the first attempt that has ever been made to collect data of this nature, and we have Mr. Barber's assurance that, through our pages, the information will, in future, be kept strictly up to date.

Historical Review of Canadian Concrete Arch Bridges

It was estimated by Edwin Thatcher that in 1904 there were only about 100 concrete bridges in America. Now, after 15 years, there are probably as many as this within a few miles of Toronto. In 1918 concrete bridges first exceeded steel bridges in the gross amount spent in any period, for, according to the Engineering News-Record's estimate covering the first nine months in 1918, the cost of bridge building in the United States was as follows: Concrete bridges, \$5,900,000; steel bridges, \$4,800,000.

Of the different types of concrete bridges the open spandrel arches are the most important, as this is the type adopted for nearly all the longer arches; this, on account of the great weight of earth-filled arches of long span. Table I lists the open spandrel bridges over 100 feet in clear span length.

The first long span Canadian arch was earth-filled. It was 92 ft. long and was built at Massey, Ont., in 1906 by Mr. W. A. McLean, now Deputy Minister of Public Highways, Ontario, but then chief engineer of the department. Besides being a pioneer in this field it may be noted incidentally that Mr. McLean probably deserves chief credit for introducing concrete sidewalks in the towns of Ontario. This is not so well known as his later connection with concrete highways. The Massey bridge was exceeded in span two years later, in 1908, when Jas. Bell built the Lynhurst bridge at St. Thomas, of clear span 116 feet, and costing about \$11,000. Next year, 1910, the palm for long span arches passed to the first long Canadian open spandrel arch, the Wadsworth bridge at Weston, Ont. This had a span of 118½ feet and was built by Barber & Young, at a cost of about \$15,000. The record spans have since been of this type. Mr. Bell's Lynhurst bridge, however, remained the longest earth filled arch in Canada until a few months ago, when

the handsome Tower Road Bridge, Halifax, was completed, of span 144 ft., by W. A. Duff, bridge engineer to the Canadian National Railways. This is a flat arch requiring no great depth of earth fill; otherwise hollow spandrels would have been more economical. Even so, this arch is probably close to the economical limit for filled arches and may not be soon exceeded by this type.

The Wadsworth bridge, at Weston, was exceeded, in length, by two bridges built in 1913. One of these was at Port Arthur, Ont.; a single span of 130 ft. in the clear, by L. M. Jones. In the same year was completed the King George arch at Oakville for the County of Halton. The county engineer was Jas. Hutcheson, and the bridge was designed and erected by Frank Barber, as consulting engineer. Besides, the main arch of span 135 ft., there are 8 concrete beam spans, making a length of bridge proper of 476 ft. The roadway is narrow for a bridge of this length, 16 ft., and it is without sidewalks. The cost was about \$60,000.

Two years later, in 1915, the palm passed to the great University Bridge, Saskatoon. This has 3 spans of 150 ft. and 7 shorter spans, making a total length of concrete of 1250 ft. The roadway is of generous dimensions, 45 ft between curbs, with 2 sidewalks of 8½ ft. It was designed by the Provincial Board of Highway Commissioners for Saskatchewan, A. P. Linton bridge engineer. Daniel B. Luten, as consulting engineer, checked the calculations and acted in an advisory capacity. The contract price was about \$400,000, but the total cost, including land damages, was \$520,000. C. J. Yorath, C.E., was city commissioner for Saskatoon.

The Saskatoon bridge was duplicated as to spans and nearly as to length the following year, 1916, by the Centre St. Bridge, Calgary, of 3 main spans of 150 ft. and 2 shorter spans, making a length of approximately 1,000 ft. of concrete. The roadway is 42 ft. with 2 sidewalks. There is also a narrower lower deck hung from the arch ribs by structural steel shapes. The bridge was designed by Geo. W. Craig, city engineer, and John F. Greene, bridge engineer, and was built by them by day labor at a cost of \$366,000.

Longest Bridge in Canada

The Saskatoon bridge is at present the longest and probably the finest concrete bridge in Canada, with the Calgary bridge a close second. But they will be exceeded in length and span by the Hunter street bridge, Peterboro, upon which, it is expected, work will commence shortly. This will have a main span of 235 ft. with 10 shorter spans, making a length from end to end of concrete of 1,365 ft. The roadway is 42 ft. with 2 sidewalks of 6 ft. R. H. Parsons is city engineer, and Harry Phelan chairman of the committee. The design is by Frank Barber, consulting engineer, in collaboration with Claude Bragdon, architect. The estimated cost is \$300,000.

The three last mentioned bridges carry, or will

carry, double lines of electric cars. The Lemieux Island bridge, last on table 1, is an aqueduct and roadway combined. It has spandrel curtain walls and thus looks like a filled arch.

Arch and Beam Spans

Besides the above mentioned seven open spandrel arches all over 100 ft. in main span, two more are mentioned in Table III. The Victoria Bridge, Brantford, built in 1910, was one of the first of this type in Canada. The arch span is only 60 ft., but 4 beam spans bring the length to 246 ft., at that time the fourth longest. It has a wide roadway with sidewalks and carries electric cars. T. Harry Jones, the engineer, has designed several other very pleasing short span arches. The other open spandrel arch in Table III. is the handsome Crawford St. bridge, in three

about midway between crown and springings. The approaches of the First St. bridge, Brandon, 3 spans of 40 ft., centre to centre, are also of this type. R. E. Speakman was city engineer. It is believed that this completes the list of open spandrel arches of Canada, except for a 3 span foot bridge in Guelph.

Long Small Span Bridges

Table III gives 12 concrete bridges, consisting of a number of small spans, but of total length of bridge proper over 200 ft. The data given on the list is, perhaps sufficiently descriptive of these bridges. The two Ottawa bridges on this list, and one on the first list, Hurdmen's and Lemieux Is., by J. B. McRae, and the Bank St. bridge are of fine appearance, especially the two latter, and are among the longest in Canada. The lately completed lift bridge over the



1. Main span of Hunter Street Bridge, Peterboro. Open Spandrel Arch of 235 ft. clear span, with ten approach spans. Length 1365 ft. (in course). 2. Tower Road Bridge, Halifax. Longest clear span (144 ft.) for Canadian earth-filled arches. 3. Hurdman's Bridge, Ottawa. Typical long concrete bridge made up of short filled arches. 4. Earth-filled arch at Massey, Ont. The first long span (92 ft.) concrete bridge in Canada. 5. Concrete Truss Bridge at Riverview, Manitoba, of span 88½ ft., built in 1917. 6. Centre Street Bridge, Calgary, 1916. Three open spandrel arches of 150 ft. span and 2 shore spans, approximately 1,000 feet long. 7. King George Arch, Oakville, 1913. Open spandrel arch of 135 ft. span with eight beam spans. 8. University Bridge, Saskatoon, 1915. Main spans 150 ft. clear; length, 1,250 ft.

spans, built by the City of Toronto. The arches are not, strictly speaking, reinforced concrete, as they have structural steel enough in them to carry the imposed loads.

Besides the 9 bridges mentioned above there are 9 other open spandrel spans ranging from 80 ft. to about 40 ft. as follows: The Fergus bridge, Wellington County, by Bowman & Connor, 80 ft. span; the Kleinburg arch, 65 ft. span for York County Highway Commission, E. A. James, engineer to Commission, Frank Barber, consulting engineer, and six by the Manitoba Highway Commission, all under 60 ft. in span. Three of these have the floor suspended

canal at Ottawa, was also mentioned, though having a steel lift span, as being the handsomest lift bridge known to the speaker. The finish of all the late concrete bridges in Ottawa is washed granite. These bridges place Ottawa in the forefront of Canadian cities as to concrete bridges.

Earth Filled Arch Bridges

Besides the longer arches given in the tables the information to hand as to earth-filled arch bridges under 200 ft. in length and of spans between 60 and 100 ft. inclusive, is as follows:

There are nine in Nova Scotia, all in Halifax, 7 of

spans 60 ft. and 2 of spans 66 ft. all single spans. All but one have 2 sidewalks and roadways varying from 15 to 33 ft. These are in addition to the 2 longer bridges, Young Ave., and Tower Road, given in the tables. They were all built by the Halifax Ocean Terminals Railway, by W. A. Duff, assistant chief engineer, and are very handsome bridges. They have all ornamental railings and the exposed surfaces have received tool treatment.

It is believed that New Brunswick has at present no concrete bridges of spans over 60 ft. In the Province of Quebec, besides the Chicoutimi River bridge, span 113 ft. and third longest earth filled arch, and the St. Bazile bridge by L. A. Vallee, both given in the tables, Magwood & Walker built the Coaticook arch, span 100 ft., in 1910, which for 5 or 6 years was the longest concrete span east of Montreal. After these the longest spans in this province are two bridges by Gauvin and Lassard, each of span 80 ft., one at Notre Dame du Rosaire, 1916, and one at St. Phelamon, 1918, each costing about \$12,000. Next to these is a bridge on the international boundary over Missisquoi River of 2 equal spans of 67 ft. each by the Vermont State engineer, and one at Ste. Marie du Monnoir of two equal spans of 60 ft. each by F. E. Came.

In Manitoba there is an earth filled arch of 60 ft. at Arden. Except for a concrete truss of 86¼ feet, mentioned later, we have information of no other arches of over 60 feet in this province. There are sixteen arches in Manitoba over 30 ft., 5 of them earth filled, 6 open spandrel, mentioned above, and 5 concrete trusses. These are all

by the Manitoba Good Roads Board, and have roadways of 18 ft. between curbs. Two of the concrete trusses are especially worth mentioning, the Riverview bridge, span 86½ ft., which is among the longest concrete trusses in Canada, and the Rat Creek bridge No. 4, in 3 spans, longest 50 ft., total length 124 ft., the only Canadian concrete truss bridge of more than one span. Great care has been taken of the railings, finish and all other details in these Manitoba bridges, and they will compare favorably in appearance with bridges in any part of Canada.

Besides the Centre St. and Mission bridge in Calgary, and the Saskatoon bridge, there are no concrete bridges west of Manitoba of spans greater than 60 ft.

In Ontario, in addition to the longer bridges given in the tables, there are at least 16 arches of spans from 60 to 100 ft. inclusive. Three by Jas. Bell, in Elgin county; Queen's, 2 spans of 80 ft.; Brewery, 2 spans of 75 ft., and Orwell 75 ft., all built in 1908.

Three by Lucius E. Allen, in Hastings county, built in 1913; Bridgewater and Bancroft, each 100 ft.; and Spry's, 80 ft.

Three by Bowman & Connor: Eramosa Tp., 60 ft.; Maryboro Tp., 80 ft., and Peel Tp., 60 ft.

Three by Frank Barber: Russel, York Tp., 60 ft.; Newmarket, 60 ft., and Kirkham, Scarboro Tp., 70 ft.

One for the Niagara, St. Catharines and Toronto (Electric) Railway of main span 80 ft., with 5 small shore spans, one of the largest when it was built in 1908.

One by C. E. Ure at Embro, 75 ft.

TABLE I.

Open Spandrel Arch Bridges with Clear Span Over 100 Feet

Name	Year	Clear span of main arch	No. of spans	Total length of bridge proper	Roadway between curbs	Sidewalks	Cost	Engineer
Hunter Street Peterboro	(in course)	235'	1 main 10 approach	1365'	42'	2 of 6'	\$300,000	Frank Barber, Engineer Claude Bragdon, Architect R. H. Parsons, City Engineer
Centre St. Bridge Calgary	1916	150'	3 main 2 approach	approx. 1000'	42'	2	\$366,000	Geo. W. Craig, City Engineer Jno. F. Green, Bridge Engr.
University Bridge Saskatoon	1915	150'	3 main 7 shorter	1250'	45'	2 of 8½'	\$520,000	A. P. Linton
King George Arch Oakville	1913	135'	1 main 8 approach	476'	16'	none	\$60,000	Jas. Hutcheon, County Engr. Frank Barber, Consltg. Engr.
Port Arthur Bridge	1913	130'	1 span	about 180'	16'	2 of 5'		L. M. Jones.
Wadsworth Arch Weston	1910	118½'	1 span	178'	16'	none	\$15,000	Barber & Young
Lemieux Isl. Bridge Ottawa (Aqueduct & highway)	1916	106'	4 equal spans	765'	20'		\$59,500	John B. McRae.

TABLE II.

Earth Filled Arch Bridges, Over 100 Feet Clear Span

Name	Year	Clear span of main span	No. of spans	Total length bridge proper	Roadway between curbs	Sidewalks	Cost	Engineer
Tower Rd. Bridge Halifax	1917	144'	1	about 200'	30'	2 of 6'		W. A. Duff, Bridge Engr. to Can. National Railways.
Lynhurst Bridge St. Thomas	1908	116'	1	about 150'	16'	1 of 4'	\$11,000	Jas. Bell
Chicoutimi River Bridge Chicoutimi County Quebec	1916	113'	3					Gagne & Jennings

TABLE III.

Concrete Arch Bridges of Spans Less than 100 Feet but of Total Bridge Length of Over 200 Feet.
Earth Filled except as noted.

Name	Year	Total length	No. of spans	Roadway between curbs	Sidewalks	Cost	Engineer
Ontario St. Bridge, St. Catharines	1912	750'	13 of 50'	26'	1 of 6'	\$141,000	W. P. Near, City Engineer. Sprague & Reppert, Consulting Engineers.
Bank St. Bridge, Ottawa	1913	626'	7 of 76'	40'	2 of 8'	\$130,000	N. J. Kerr, City Engineer.
Hurdman's Bridge, Ottawa		about 500'	7 spans				J. B. McRae, Consulting Engineer.
Smith Street Bridge, Peterboro	1910	385'	3 of 94'	26'	1 of 5'	\$35,000	T. S. Hay, City Engineer. W. J. Francis, Conslt. Engr.
Crawford St. Bridge, Toronto (Open spandrel)	1914	292'	1 of 81' 4" 2 smaller	21'	2 of 6'	\$45,000	C. W. Power, Chief of Dept. of Bridges. J. S. Burgoyne, Chief Asst. on Design. L. N. Edwards, Chief Asst. on Construction.
Edindale Bridge, Simcoe County	1907	286'	4 of 60'	16'			Connor, Clarke & Monds
Mission Bridge, Calgary	1915	284' 6"	1 of 86' 1 of 76' 2 of 34'	40'	1 of 6'		Geo. W. Craig.
Old Mill Bridge over Humber River York County	1916	282'	1 of 82' 2 of 62'	25'	none	\$45,000	Frank Barber, Engineer. Alfred Chapman, Architect.
Chaude River St. Bazile, Que.	1917	about 280'	3 of 79'				L. A. Vallee, Chief Engineer, Dept. of Highways, Quebec
Montreal Aqueduct	1917	251'	3 of 57'	36'			Mouchel & Partners and Dominion Bridge Co.
Young Ave. Bridge, Halifax	1917	about 250'	2 of 96'	48'	2 of 16'		W. A. Duff.
Victoria Bridge, Brantford (Open spandrel)	1910	246'	1 of 60' 4 shorter	38'	2 of 11'	\$50,000	T. Harry Jones.

One by Chas. Talbot, St. John's, Neiddleles Co., 75 ft.

The historic Massey bridge of 92 ft. span was mentioned above. Although of smaller dimensions than those adopted for bridges here recorded, the Guelph Prison bridge, also by W. A. McLean is worthy of mention on account of its architectural beauty. It has a main span of 50 ft and 2 shorter side spans.

Concrete Truss Bridges

An historical survey of concrete arches would be incomplete without a short review of concrete truss bridges. These are generally arches with the skewbacks tied together by lower chords, and generally with the floor suspended from the arched chords on a level with the lower chords. The first was built by Considre, in France, in 1904. The first in America was the approach to the Sparkman St. bridge, Nashville, Tenn. The first in Canada and second in America was the Middle Road bridge, between the counties of York and Peel, span 79 ft., designed by Barber & Young, and built in 1909 by O. L. Hicks, contractor, one of the pioneers in concrete building in Ontario. In 1911, Barber built two other trusses: Freeman's bridge, York county, span 91 ft., and until 1919 the longest Canadian truss; and Haliburton, span 55 ft., and by 1913 had built 9 of this type; also 3 others

in York county, Highland Creek, Birrels on Yonge St., North of Toronto, and Eckhardt, near Unionville, one near Collingwood, and Simpson's and Sproull's, in Amaranth township, near Orangeville. Up to this time the concrete truss had not appealed to other engineers, but in 1913 Bowman & Connor built one at Eden Mills, of span 50 ft. In 1914 Barber built eight others, mostly in York county, and Bowman & Connor built 4 others in Wellington county. After 1914 concrete trusses became more generally distributed, and at present there are 56 of this type in Canada, 25 of them of 60 ft. span or over, including 4 on the Toronto & Hamilton Highway, of spans from 100 to 120 ft. now being completed. These were designed by Mouchel & Partners for H. S. Van Scoyoe, chief engineer to the Commission. The five built by the Good Roads Board, Manitoba have already been mentioned.

Concrete Arches Over 60 Ft. Span

Concrete arches of all types and of spans over 60 ft. or total length of bridge over 200 ft. are distributed as follows: Nova Scotia 11, Quebec 7, Manitoba 2, Alberta 2, and Saskatchewan 1, Ontario 57, making 80 in Canada. It is remarkable that approximately one-third of these are concrete trusses.

Concrete beam and slab bridges are not here being considered, but it may be said that although there are

a great many of quite short span there are few of spans over 50 ft. and not more than a half dozen of considerable length, the two C. P. R. viaducts at North Toronto of length 380 ft. and span of 35 and 37 ft. being the longest.

The speaker compared the longest Canadian concrete viaducts and the greatest Canadian arches with the world's bridges. There are 32 concrete arch bridges and viaducts longer than the Saskatoon bridge

and 29 longer than the Peterborough bridges will be. There are 13 arches greater than the main span (235 ft.) of the Peterborough bridge, 6 of these in America.

Mr. Barber made it plain that his figures were subject to correction and additions, which he will welcome. In order that this interesting history may be complete as possible. Engineers are asked to communicate direct with Mr. Barber or through the Contract Record of any errors or omissions they may note.

Whitley Plan for Improving Labor Status

Joint Standing Industrial Councils Recommended to Provide Remedy for Differences Between Employers and Employed

JOINT industrial councils have been proposed in what is known as the Whitley plan as a possible remedy for the differences between employer and employed. The recommendations of this scheme, so far as these councils and their modus operandi are concerned have been attracting wide-spread attention on account of the sound principles that are involved. The extent of industrial unrest at the present time is engaging the attention of both employer and employed and any sane, practical method that will alleviate the differences will be received with open arms. On account of the practical suggestions embraced in the so-called Whitley report, it has been welcomed as a scheme worth profound consideration, and its application will be watched with deep interest.

The Whitley plan derives its name from J. H. Whitley, the chairman of the committee appointed in England to report on the labor problem. This committee, numbering fifteen, embraced employers, trade union officials, economists and other specialists. The recommendations of this committee favored the establishment of joint industrial councils representing employer and workpeople. In many industries in England these councils have been put into operation and, to all reports, are proving eminently satisfactory.

Canadian interest in the Whitley plan has lately been stimulated by the condition of labor unrest all over the country and by the reported success of the scheme in England. The city of Toronto has taken the initiative in the matter of applying the scheme in Canada. Representatives of the employers and employees in the building trades have had a meeting with the result that a committee is drawing up a basis of action which will be submitted to the trades' unions and employers' organizations for consideration and ratification.

To enlighten our readers as to the nature of the Whitley scheme and the operation of the Joint Industrial Councils, a resume is herewith made of the Whitley report:

Objects of the Whitley Report

The Whitley committee were asked to advise the government on two points:

(1) To make and consider suggestions for securing a permanent improvement in the relations between employers and workmen. (2) To recommend means for securing that industrial conditions affecting the relations between employers and workmen shall be systematically reviewed by those concerned, with a view to improving conditions in the future.

The committee found that the best way to deal

with the first point was to settle the second. They, therefore, recommend "means for securing that industrial conditions affecting the relations between employers and workmen shall be systematically reviewed by those concerned" as the best way of "securing a permanent improvement in the relations between employers and workmen."

Joint Standing Industrial Councils

The means they recommended were the establishment of Joint Standing Industrial Councils. As joint councils, these would bring employers and workpeople together; as standing councils they would ensure regular meetings for discussion of matters of common interest; as industrial councils they would throw into relief the questions that concerned each industry as a whole, foster a common feeling for the industry, and help both sides to realise the social importance of the industry as distinct from their private interests. These regular meetings to discuss matters of common interest would, it was thought, produce an atmosphere in which disputes when they arose could be settled by an appeal to reason. The subjects from which disputes arise would come up for discussion before feeling had been excited. Mutual misunderstanding and unnecessary suspicion would be reduced to a minimum.

Will Give Workers a Status in Their Industries

The primary object of Industrial Councils, then, is to regularize the relations between employers and employed. But they will serve another urgent need, and, in so doing, will give to workpeople a status in their respective industries that they have not had hitherto. There is a large body of problems which belong both to industry and to politics. They belong to politics, because the community is responsible for their solution and the State must act if no other provision is made; they belong to industry, because they can be solved only by the knowledge and experience of the people actually in industry. Such problems are the regularization of employment, industrial training, utilization of inventions, industrial research, the improvement of design and quality, legislation affecting workshop conditions—all of them questions which have hitherto been left in the main to employers, but which in reality constitute an important common interest on the basis of which all engaged in an industry can meet. The termination of the war has brought with it a mass of new problems of this nature; for example, demobilization, the training of apprentices whose apprenticeship was interrupted by military service, the settlement in industry of partially disabled

men, and in general, the reconversion of industry to the purpose of peace. It is urgently necessary that the government should be able to obtain without delay the experience and views of the people actually in industry on all these questions. It proposes, therefore, to treat Industrial Councils as Standing Consultative Committees to the government and the normal channel through which it will seek the experience and advice of industries. Further, many of these problems, can be handled by each industry for itself, provided that it has an organization representative of all sections and interests within it. The establishment of Industrial Councils will, therefore, make unnecessary a large amount of "government interference" which is at present unavoidable, and substitute for it a real measure of "self-government" in industry.

Constitution of Industrial Councils

The Whitley committee recognised, as a condition of fundamental and governing importance, that the circumstances of different industries vary and that the organization of each industry should be adapted to its special circumstances. They left, therefore, the initiative in establishing Industrial Councils and the settlement of all details as to representation and distribution of functions to the people in industry to settle for themselves.

Two conditions, however, they lay down as essential to any satisfactory arrangement:

(1) That Industrial Councils shall consist exclusively of representatives of organizations, i.e., trade unions and employers' associations; where organization is insufficient on either side, the scheme is inapplicable. Joint Industrial Councils must not displace, but be built on the existing organization; those individuals who will not be represented under this provision have their remedy in joining their appropriate employers' association or trade union.

(2) Industrial Councils must work through decentralized machinery. Where an industry is distributed over the country District Joint Councils will be found necessary, which would work within lines laid down by the National Joint Council and undertake all district business. Further, where the circumstances of an industry permit, further decentralization is provided for in the recommendation that works committees be established. Similarly, provision can be made for sectional questions, such as the wages of a small craft or of a grade of workers not confined to one industry, to be dealt with by sectional joint committees, or even excluded from the purview of the council.

Works Committees

In large firms satisfactory relations between employers and employed and an extension to workpeople of any real control over the conditions of their work are possible only through Works Committees, or some equivalent organization based on the workshop. But Works Committees in many industries would be an innovation, and the existing trade union organization does not always contain provision for them. The Whitley committee, therefore, recommend that where Works Committees are made a part of the scheme they should be established only on lines agreed upon by the employers' organizations and trade unions represented on the National Councils. The question of establishing Works Committees will naturally form one of the first subjects for consideration by a National Council in an industry where they are not already the rule.

While there is no doubt that every industry has

problems which can be solved only if the experience of every grade and section of the industry is brought to bear on them, hitherto the tendency has been for every grade and section to go its own way. Whenever the government wishes to ascertain the needs and opinions of an industry, instead of one organization speaking with a single voice, a dozen organizations speak with a dozen voices. The different sections and interests are organized and can put their point of view; the industry as a whole has no representative organization, so that the general interest of the industry may be overlooked. Sectional interests often conflict; there is no need, for example, to disguise the conflict of interests between employers and employed; and the Whitley report proposes nothing of the nature of compulsory arbitration, nothing that will limit or interfere with the right to lock-out or strike. But no one in industry wants an unnecessary stoppage; these can be prevented only by the representatives of conflicting interests meeting to thrash out their differences; and all the problems that now face industry after the war call for continuous consultation and co-operation of all sections, grades and interests. For every reason, therefore, Industrial Councils fully representative of all sections and interests in each industry, are an urgent necessity.

Present Organization Limited

In some industries there exist already Joint Conciliation Boards performing some of the functions of Industrial Councils. These are, however, as a rule, limited either in the work they undertake or in the sections of the industry which they represent. Although, therefore, existing Joint Boards will in many cases provide the basis for Industrial Councils, they cannot handle the problems, referred to above, with which the industries of the country are now faced after the war. What is needed is an organization representing the whole industry and capable of speaking for all the firms and all the workpeople employed in it. The government's adoption of the Whitley report is simply an invitation to the industries of the country to organize themselves in this way, for their own benefit and for the benefit of the community.

Toronto-Hamilton Highway Commission Reserves Right of Way Beside Road

THE combined councils of Mimico, Etobicoke and New Toronto recently made a protest to the Toronto - Hamilton Highway Commission against the policy of reserving 20 ft. of land along the north side of the highway. Mr. Geo. Gooderham, chairman of the commission, refused to comply with their request that the restrictions be removed. He said it was only a matter of time before the commission would requisition all buildings now within the forbidden area. It was the intention, he stated, to build a second highway the same width as the present one, along the north side of the radial line, and that if this was to be done the 22-foot strip must be maintained.

The Quebec Government has made grants of land, totalling 1,570,000 acres, to aid various projected railway lines in the province. The grants run to 4,000 acres per mile. The railway companies are the Quebec Central, Rouge River, Shefford, Bagot and Missisquoi, Canada & Gulf Terminal, and two companies which are not named.

Durability of Pavements

Discussion Offered at Ontario Conference of
Road Superintendents and Engineers
Mentions Results of Old Country
Practice

By D. T. Black*

THE only feature which may be termed permanent about a highway is its location. This may also be changed or widened, but there is more likelihood of its being permanent than any surface on the highway. Permanent is a very misleading word to be used for a pavement of crust for travel, and in its place I prefer the expression "More or less durable."

One of the difficulties we have always had with regard to public improvements has been that so many side issues are raised, which are enlarged upon and criticized. A very large percentage of this controversy can be traced to the misapplication of this word permanent and I therefore recommend that all engineers, superintendents and others interested in this work never use the word in reference to the wearing surface.

It is gratifying to know that the narrow-mindedness of many local authorities in regard to highway construction is fast disappearing, and in its place there is a get-together movement to carry out plans which will be beneficial to the former and his district as well as the province at large. It is almost impossible to prophesy what the future requirements will be on the provincial highways, but it is safe to say that the width of the surface must be sufficient to provide for the safe passage of two vehicles going in opposite directions at a high rate of speed. It is essential that the construction be of a sufficiently durable material, to keep a smooth surface for a number of years at little maintenance expense, without an excessive initial expenditure. It must also be remembered that the traffic will consist of a large number of very fast light vehicles, as well as a fair percentage of heavy motor trucks.

The engineer commences his duties with three very important points. (1) A wide surface, (2) durable construction to provide for light, heavy and fast traffic, (3) initial cost reasonable, maintenance cost light. Before erecting a building the architect considers his foundation and drainage; the road builder must as carefully do likewise. To quote from Mr. A. W. Campbell, "The three important points in road construction, are drainage, drainage, drainage," therefore point four for the engineer is, drainage, drainage, drainage. Under this heading it must be remembered that to provide for fast traffic, short culverts are very dangerous, and guard rails should be very strong and of a white or prominent appearance, easily seen from a distance and there should be no narrowing of the highway at this spot. The matter of drainage places a very great responsibility on the shoulders of the engineer and must be gone into thoroughly and very deeply because the durability of his pavement and the maintenance charges are governed entirely by the condition of the foundations.

Before selecting a wearing surface, it is desirable to know what has been done elsewhere. To travel over the Wayne County highways one would naturally

come back a concrete enthusiast. To travel over the New York State highways, a bituminous surface would most likely be the chosen one, while in Ohio the brick surface is a very tempting and delightful surface to travel over. We must, however, remember we are in Ontario, and our natural resources must first be closely examined, tested, and in some cases, searched out. It would be unwise to import brick to a district containing abundance of stone, sand, water and a good cement works within easy reach; on the other hand it would also be unwise to consider brick when a bituminous surface can be constructed by using local material and a railroad conveniently near. It is also well to remember that a bituminous surface will stand more abuse than a rigid surface such as concrete or brick.

Old Country Practice

The opinion in Great Britain and France is that if a simple water-bound macadam does not last two years without resurfacing, it should be changed to another type of construction or superficially tarred to increase its life if possible, to or beyond this period. English experience indicates that 120,000 tons of traffic per yard width will wear out the best water-bound macadam in a year, and when the traffic reaches 50,000 tons per yard width per annum or 135 tons a yard width per day, water-bound macadam should not be considered. The French estimates the traffic limit of water-bound macadam to be 1,000 "collars" a day for the whole width of the road. A "collar" is a single horse drawn vehicle, and an automobile is equivalent to three "collars."

Although the limit of water-bound macadam has not yet been properly established, owing to the differences in construction and location, still it shows the necessity of having proper censuses taken on all roads which seem to be rapidly yielding to traffic, also on roads about to be improved, as a guide to the type of construction to be adopted.

In France and Britain the use of tar on the surface about doubles the life of the water-bound macadam, and from the 1916 New York Highway Report, I find that 490 miles out of 1,950 miles constructed was new macadam surface treated with tar and asphalt oils.

Concrete highways are more extensively used in the United States and Canada than in Europe. Abroad they are objected to as being too hard, insufficiently resilient and too liable to crack. Several county superintendents in the New York highway system have made the same statements, and are using less of this construction.

The efficiency of bituminous macadam in England is well established by many examples which have been under hard wear for years, and a number of tar macadam roads have endured from 30 to 35 years with only occasional resurfacings. In Sheffield a tar macadam road with a traffic of 36,000 tons per yard width per annum has been in service for 22 years at an average cost, including the original expenditure, of 8 cents per square yard. It is claimed that it can still be maintained for many years at an annual cost of 6 cents per square yard. Many other bituminous pavements in Great Britain have been in use for long periods, and are still giving excellent service at very little maintenance cost. From the 1917 New York Highway Report, I find that 34 per cent of the construction in 1916 was bituminous macadam; 25 per cent was water-bound macadam with bituminous surface treatment;

*City Engineer of Welland, Ont.

20 per cent was water-bound macadam; 15 per cent concrete and 6 per cent brick.

Traffic Limit for Bituminous Macadam

The traffic limit at which bituminous macadam seems to become uneconomical is estimated at 1,000 tons per yard width per day, at which rate the top layer would probably wear out in about four years. This is a very heavy traffic and from five to ten times that on our ordinary rural highways. It seems, therefore, unnecessary to dwell extensively upon any types of construction more expensive than bituminous macadam concrete or even carpeted water-bound macadam.

The penetration method adopted in England much resembles the system generally used in Canada with the exception in some cases that the hot pitch softened with oil is hand poured and sometimes mixed with an equal part of hot sand. In France the penetration method is not much favored. The mixing method, is, however, highly commended all over Europe, and although under different names, the system chiefly consists of heating granite, trap rock, hard limestone or slag, until all moisture is driven off and mixing it with hot tar at the same temperature, usually 225 to 350 degrees. The granite and trap rock mixture in most cases receives the sand filler, whereas slag, to which the tar or bitumen clings better and which is more readily compressed by roller and traffic, filling up the interstices, does not require such a filler.

Annual Report of Canada Cement Co.

AFTER writing off \$1,150,746 for depreciation and special equipment, the earnings of the Canada Cement Co. for the past year totalled \$2,215,708, a decrease of \$645,539. Deducting fixed charges and the preferred dividend, the amount left for common dividend is \$1,060,644, a fall of \$633,537. The surplus carried forward is \$100,644, making a total surplus of \$2,677,643.

The president states that "during the past year, the demand for cement did not equal the demand during 1917. The reason for this is, we think, due to the curtailment of all unnecessary work and to the scarcity of labor. As the power company which supplies power to your plant, No. 8, at Port Colborne, failed to deliver the power, we were unable to operate this plant and had to ship the cement consumed in the territory and usually supplied by this plant, from other plants, which, of course, caused considerable loss.

"Your directors feel that the demand for your product during 1919 cannot be less than it was in 1918, and should be more. At the same time we must not forget that since 1914 your cement plants have not been operating to anything like capacity, and a number of them have been shut down since 1914, so that when the demand does improve we will be called upon to start up these plants, involving a considerable cash outlay for materials, wages, etc. Moreover, it will be unreasonable to expect these plants to operate at their usual efficiency for some time after they have been re-started.

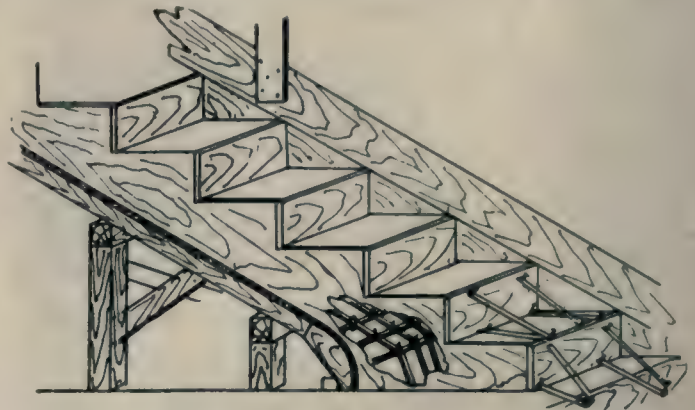
"For a number of years your staff have been studying different methods of recovering potash as a by-product from the kilns. There is no doubt that this can be successfully and commercially done, and we expect that during 1919, at least one of your plants will be equipped to recover this by-product, and if the results are as anticipated your other plants will undoubtedly be equipped in a similar manner."

Reinforced Concrete Stairs

THE installation of reinforced concrete stairs offers a splendid field for ingenuity. A recent design considering economy, stability, simplicity of construction and speed, has been found most adaptable.

Build soffit of 7-8-in. shiplap laid horizontally on 2-in. x 6-in. bearers, supported by 4-in. x 4-in. headers on 4-in. x 4-in. shores, placed as weight and length of stairs require. The shiplap should extend 6 inches past the stair line on both sides, then nail a 2-in. x 6-in. flat to clear stair line 2 inches.

Lay out the risers and treads on smooth side of 2-in. plank stringers, risers to slant in or toward their



A Reinforced Concrete Stairway Design

slab $\frac{1}{2}$ -in. if without nosings; place the stringers on the slab and set the risers, beveled at the bottom to allow free use of finishing tools. Risers are to correspond in length to finished rise and are set flush with the finished tread.

Place one 4 x 4, or more, if width of stair requires, longitudinally in the center of the stairs, and wire firmly through the slab to headers beneath to prevent floating; use 4 x 4's as clamps across stringers and wired to headers, spacing to be determined by thickness of slab and width of stairs.

British Import Restriction Removed

An important announcement has been made by the Secretary of State for the Colonies to the effect that all restrictions on imports into England from British Colonies have been removed. It is made clear, however, that this refers only to goods produced or manufactured in the colonies.

It is pointed out, at the same time, that this offers a splendid opportunity for Canadian manufacturers, as British stocks, in general, are low. The announcement, of course, amounts practically to a preference in favor of Colonial goods. It will doubtless mean, too, the establishment in Canada of numerous branch factories of United States and other foreign industrial concerns.

Aqueduct Claim Settled

The City of Montreal Commissioners have decided to pay an arbitration award in the case of Quinlan and Robertson, amounting to \$12,000. This is an old claim, relating to a contract for work on the aqueduct.

Preparing Contracts and Specifications

By E. A. James, B. A. Sc.*

WHEN a person, company or corporation which we may call the owner, wishes to carry out a piece of engineering construction, he obtains the services of a qualified engineer with whom is entrusted the design and supervision of the work. Usually the owner has not the special experience, the technical skill, nor the necessary equipment to undertake the responsibility himself. In the interest of efficiency, it is best to trust the design and supervision to an engineer, and the actual construction to a responsible contractor. The engineer does not usually possess the necessary plant or equipment to carry out the work, at the same time, it is unwise to entrust the design and construction to one party, as in case of dishonesty the owner might be grossly deceived. The employment of an engineer and a contractor is a check.

Reason for Plans and Specifications

In order that the contractor may obtain a definite idea as to the extent and conditions governing the work to be undertaken, the engineer must provide



Mr. E. A. James

both graphical and written documents. These documents provide a basis on which the different contractors can prepare their tenders. In order that the work may be carried out in a harmonious manner, there must be some definition of the relations and authority of the persons involved. The plans and specifications should serve as a guide to the contractor in regard to the extent and shape of the parts, preferably embodied in the plans, while the quality of the material and the workmanship should be stated in the specifications. On account of the multiplicity of details whose character would so materially effect the cost of the work, oral instructions must not be relied on. In the interests of mutual understanding, business efficiency and clearness as to detail, plans and specifications for work of any considerable magnitude are essential.

When the plans and specifications for the proposed structure are well under way, the engineer issues a statement asking for tenders. The form and length of this document varies with the locality, character and extent of the work. Often small posters circulated in the neighborhood of the undertaking will attract the attention of those interested; this, of course, applied to work of small proportion. In case of large undertakings, to which the attention of specializing contractors must be drawn, it is usual to advertise in the technical or daily press; such advertisements should give some definite details as to the character and extent of the different parts of the work. It is usual to include certain instructions to bidders as regards the use of standard form of tender, delivery to specified address at certain time, portions of the work open to tender of any one bidder, provisions for prescribed security, items for which prices are to be quoted, and the owner's right to reject any or all bids.

Types of Contracts

There are three general types of engineering contracts. In the first the engineer specifies the end result or required performance to be attained, and leaves the contractor free to obtain this result by whatever means he may deem best. The contractor is in this case held responsible for the method of construction. In the second, the engineer specifies in detail the materials and methods, and takes responsibility for the result. In the third class of contract the engineer prescribes the character of materials and the method of construction, and also the results to be attained. This latter case is often illogical and unreasonable, and may easily lead to complications between the parties involved. In road work the second type of contract is the most commonly used, and seems to be adequate to produce satisfactory results.

Length of Contract

The amount of detail and the length of a contract is determined mainly by the character and extent of the undertaking. Often a sketch and a note stating that the contractor will supply all material and labor are sufficient for small work. It sometimes happens, as in the case of a machine or commodity covered by letters patent, or entailing the use of some secret process, that the contractor is simply asked to deliver the article or commodity capable of a stated performance, or able to meet certain specified tests. The fullness of the specifications will depend on the arrangement with the contractor, if, as in the case of a structural steel work, the contractor is to design his own shop details. The manner in which the contractor is to receive his profit is another factor governing the length of the contract. So-called lump sum or unsecured contracts call for more detail than do those let on a cost plus percentage basis or secured contract. This precaution is necessary to safeguard the owner's interests, because the contractor, in case of a secured contract, may be inclined to skimp the work to increase his own profit. Thus, in accordance with the complexity of the work, and the character of the contracting parties, construction contracts are composed of

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agreement, specifications and plans in varying proportions.

Relation of Specifications to Plans

Graphical drawings or plans are capable of informing those interested with a comprehensive idea in a very short time. Some details are much more readily understood when shown graphically than when described with reams of written description. Drawings often help the designer to detect errors that might otherwise escape his attention. The specifications, besides other functions, are to compliment or explain the plans in such matters as it is impractical to show on them. It is usual to write the specifications after the plans have been drawn, and in virtue of this they are accorded precedence over the plans.

Relation of Agreement to the Specifications

Specifications are intended as a guide in regard to the quality of the materials and workmanship. They should set forth the extent, character of the work, necessary inspection and required tests. To avoid disputes and delays, certain general clauses are inserted defining the authority and procedure of the contractor, the engineer or their respective representatives. Thus, the specifications are usually divided into two parts, the general and the specific clauses. On the other hand, the agreement states that for a certain consideration the contractor agrees to carry out the work in accordance with the plans and specifications. It is essentially a legal document, indicating the mutual assent of the owner and the contractor to carry out the work in the prescribed manner. The agreement, being a formal promise, is given a precedence over the specifications. While in the case of large undertakings, the contractor and owner are required to sign the plans, specifications and agreement; in the case of smaller work their signatures are required only to the agreement.

Desirable Characteristics

The ideal specification is one that furnishes a wholly sufficient guide to the accomplishment of the desired purpose; that provides for every possible contingency which may arise, and is couched in language which not only means exactly what it was intended to mean, but is impossible of any other interpretation. Specification writers should aim to comply with this ideal demand as nearly as possible, and there are certain considerations which, if given attention to will guide the writer in the proper direction. Among other things a contract should be legal, fair, accurate, brief, clear and have convenient arrangement.

Legality

In order that a contract may be lawful, it must conform to certain legal requirements of common and statute law. According to Johnson and other authorities, a contract must possess the following essentials: competency, legality, mutuality and consideration. By competency is meant that those entering into the contract must be of age. Then, in dealing with societies, corporations and governments, the authority of their representatives to act for them must be clearly established. In order to be legal, a contract must not violate statute law, nor must it be based upon any fraudulent transaction or act. Persons entering into a contract must have a mutual understanding of its contents. Where one or the other of the parties can prove having been misinformed or misled into a conception of the work not borne out by the specifications, the contract may be set aside. For large undertakings,

contracts are usually under seal, but in smaller works there must be some valuable consideration transferred between the parties to make the contract secure in the eyes of the law.

Fairness

Above all things, a contract should be fair. To require the compliance with unjust conditions will lessen rather than increase the number of bidders. Then, in case of litigation, the engineer's case is greatly strengthened should the provisions of the contract in their fairness appeal to the judgment of the court. A particularly unfair clause, in some contracts, calls for the contractor to guarantee the engineer's plans. The engineer should accept responsibility for his own plans and specified quantities within reasonable limits. In his interpretation of the requirements of the contract, the engineer should not seek to read into the clauses any meaning which would not be apparent to any neutral technical reader. The engineer should not assume arbitrary powers, for when a contract is entered into, both parties stand equal before the law. The practice of inserting, either in the specifications or the contract, a clause making the engineer judge and arbitrator in any difference that may arise between the owner and the contractor, and providing that his decision in all cases shall be final, is as unfair as it is often illegal.

Accuracy

All quantities mentioned in the contract should be as accurately determined as possible. In the case of an unsecured contract the contractor may be grossly deceived if such quantities as excavation yardage are not accurately given. In the description of the materials and the quality of the workmanship, the engineer should be as complete and definite as possible. Such phrases as "proper and sufficient" do not leave in the contractor's mind a very accurate idea of the requirements, and their vagueness provides the contractor with an excuse for careless and unsatisfactory work.

Clearness

If the contents of a contract is clear, the chances of dispute in regard to their interpretation are greatly diminished. Ambiguous descriptive terms must be avoided if a workable scheme is to be evolved. The engineer must be careful that the contents of one clause shall not clash or contradict that of a succeeding clause. It should also be the duty and desire of the writer to set forth all possible information with which the contractor can reasonably expect to be supplied. No information that would help him to secure the required result should be withheld from him.

Brevity and Convenient Arrangement

In order that the subject matter of the contract may not be unduly burdensome, it should be as brief as prudence will allow. Accuracy and clearness should never be betrayed for the sake of brevity. In compiling the different parts of the contract, the writer should arrange the clauses in a convenient and orderly manner. The specific clauses should follow one another in order of their occurrence in the process of construction. Care should be taken not to incorporate general clauses in the specific clauses; if this is done the parties will be able to obtain the desired information much more readily and intelligently.

The Agreement

The agreement, often spoken of as the contract, contains the formal promise of the contractor to carry

out certain work and supply certain materials for the consideration mentioned. It is essentially a legal document, outlining the business relations existing between the parties involved. The length and detail of the agreement, of course, varies with the character of the work. Some of the more important provisions will be outlined and elaborated upon in the following paragraphs. Many of the items mentioned below do not represent separate clauses in case of small work, but rather ideas that should be embraced therein. 1. Title clause; 2. description of undertaking; 3. risks and obligations; 4. consideration; 5. liquidated damages; 6. disputes and arbitration; 7. dismissal of the contractor; 8. assignment of the contract; 9. binding of heirs; 10. legal closing.

Title Clause

Preceding the actual promise is a title clause naming the parties and their status under the contract. The following is a simple illustration:—

This Agreement made the day of
A.D. One Thousand Nine Hundred and
BETWEEN:

.....
hereinafter called the "Contractor" of the first part
and
The Municipal Corporation of the
of hereinafter called the
"Corporation" of the second part.

Description of Undertaking

Only a very concise description of the work is necessary, such as its location and the enumeration of the principal parts, stating that the contractor is to supply all material, tools and appliances for the carrying out of the project. Should it happen that the owner is prepared to provide certain materials and equipment, it should be clearly stated in this clause. It is usual to include in this connection the provision that the contractor is to provide the necessary security and to carry out the work in accordance with the plans and specifications and under the supervision of the engineer. A separate clause is often added for the inclusion of any specified documents in large contracts.

Risks and Obligations

The responsibilities that the contractor assumes must be stated here, else he may secure release from the contract on the ground of unforeseen difficulties or accidents. Any accidents or failures which are due to the contractor's operations, are justly charged against him, however there are certain unforeseen difficulties that the contractor cannot fairly be held liable, for example, the so-called acts of God, such as destruction due to electric storms or earthquakes. In case of accidents due to the methods of construction, it is often held that responsibility must be assumed by him who proposed the method.

Consideration

In consideration of the services which the contractor agrees to perform, the owner must promise remuneration. This clause represents the duty of the owner in respect to the monies due to the contractor. The payment may take the form of a lump sum or a unit price per unit of measurement; both of these would be considered unsecured as the contractor is not secure against loss. On the other hand, payment may be made on a cost plus percentage basis, to which sometimes is added a restriction that the total cost must not exceed a certain sum. If no restriction is added, the contract is considered secure, the contractor being se-

cure against loss. The prices for extras and the basis for payment of force and material account work should be stated in this section of the agreement. An important matter concerning the money due the contractor, and one that should never be overlooked, is the collection of royalty when the carrying out of the work entails the use of some process under patent. This will be more fully explained under the terms of the specifications.

Liquidated Damages

If, as is usual, the date of commencement and completion of the work are stated in the specifications, no further notice is needed in the agreement save to provide for the collection of damages, in case the time limit is not adhered to by the contractor. These damages are spoken of as "liquidated damages," meaning amounts settled on beforehand. The question of collecting these damages is a delicate one in the courts. There must be no intention of penalty in this matter, but the amount must be arrived at in proportion to the actual loss to the owner owing to the incompleteness of the work. The owner is frequently of this right because the damages stipulated are excessive in amount. It also often happens that the owner is unable to collect any damages owing to his own tardiness in carrying out his part of the obligations. While the provision for a bonus for earlier completion is not essential for the legality of the clause, yet it undoubtedly enhances the fairness of the contract in the eyes of the law.

Disputes and Arbitration

If disputes arise over technical matters in the interpretation of the plans or specifications, the engineer should settle these himself. This procedure will be upheld in the courts, providing there is no appearance of partiality or fraud. However, when disputes arise over business matters of any magnitude, such as alterations or payments to the contractor, it is often advisable to provide for their settlement by means of an independent tribunal. The character of this tribunal should be set forth in the agreement, and should provide fair representation for all parties involved.

Dismissal of the Contractor

To protect his interests, the owner should have the power to terminate the contract, providing the contractor fails to fulfill his obligations, but the owner must have adequate reason for so doing. The engineer should here stipulate the owner's right to take over the materials and equipment, and his power to undertake the completion of the work by day labor or by any means he may consider best. The method of assessing the cost of this work should be clearly set forth here. All liens or formal claims filed against the contractor should be required to be discharged from the monies due him by the owner.

Assignment of the Contract

In works which include the use of different trades, it is usual to state in the agreement that the contractor may not sublet any portion of the work contracted for without the consent of the engineer, otherwise the work might be delegated to irresponsible and incompetent persons.

Binding of Heirs

In agreements it is customary in referring to the contractor to add—"For himself, his heirs, executors, administrators and assigns." To avoid the repetition of this phrase in more elaborate agreements, it is com-

mon to state the binding of heirs, etc., of the contracting parties in a separate clause.

Legal Closing

The closing entries of the agreement are usually to a prescribed form, calling for a clear statement of the date, places and signatures and witnessing.

General Clauses of the Specification

There is a great difference of opinion as to the contents of this part of the contract. It is difficult to draw the line between clauses that should be incorporated in the agreement and those in the general clauses of the specification. Besides others, the following are usually treated in this part of the contract, and their contents will be described rather briefly in the following order:—1. Authority and definitions; 2. contractor's undertaking; 3. quality of materials and work; 4. powers of the engineer; 5. inspection; 6. security; 7. alterations; 8. extras; 9. collection of royalty; 10. order and progress of work; 11. disposal and storage of materials; 12. adjustment to existing works; 13. progress estimates and payments; 14. disorderly employees; 15. public convenience; 16. protection of monuments or stakes; 17. barriers, lights and watchmen; 18. final clean-up.

Authority and Definitions

It is advisable at the outset to set forth in this clause definitions of the terms which refer to the contracting parties and their representatives. The meaning to be attached to the words "Contractor," "Engineer," "Inspector" and "Owner" should be clearly and concisely stated here.

Contractor's Undertaking

This description should not include the character of the work, but rather a recital of the fact that the contractor must provide all materials, labor and tools for finally delivering over the completed structure. It should also be stated that the tender price includes payment for incidental work of minor importance not mentioned, but obviously necessary for the proper completion of the work.

Quality of the Material and Work

This is a general clause stating that the quality of materials and work must be of high standard. The authority of the engineer to demand the removal and reconstruction of any parts he may deem faulty should be stated here.

Powers of the Engineer

When the contract is let, the engineer assumes new and onerous duties; he must, in a general way, direct the work and interpret and enforce the terms of the contract. Questions of purely business concern may be settled by others, but in technical matters the engineer should be supreme and should be given power to state whether the plans or specifications are to be followed in the case of actual or alleged disagreement in the contract.

Inspection

In order that the engineer may know that the work is being carried on in his absence in accordance with the terms of the contract, he must provide for the appointment of an inspector on work of any considerable magnitude. The inspector must be given power to inspect all materials, both on the site of the work and at the plant of manufacture. It is usual to state in this clause the inspector's authority to reject de-

fective materials, as well as his lack of authority to permit diversions from the terms of the contract.

Security

Besides the requirement that the bidders forward a marked cheque of prescribed amount to indicate their sincerity as bidders, it is usual to require the contractor at the commencement of the work to provide the owner with an approved bond or surety for the faithful performance of the work. This bond may be supplied by persons, in which case their solvency must be clearly established. It is preferably supplied by a bond or surety company.

Alterations

Due to conditions not anticipated, such as the inability of the contractor to secure materials specified, the engineer must have some latitude as regards alterations in the specifications. In the case of a secured contract, where the contractor is immune to loss, changes by the engineer are not regarded seriously; but in the case of an unsecured contract, this procedure is viewed quite differently. The engineer's right in this latter case to make alterations in the plans and specifications, without involving the drawing up of a new contract, should be clearly limited. It is common to limit alterations to ten per cent. increase or decrease of the cost of the undertaking. Work carried out in accordance with alterations may involve the payment of extras, depending upon their character and magnitude.

Extras

The question of payment of extras is more productive of disputes than any other consideration in the contract. Any excessive work over that defined in the plans and specifications may be truly termed an extra. The price of extras should be clearly set forth in the agreement, and the contractor's tender should include his rate of payment. Extras should only be allowed on written authority of the engineer, and it is often well to require that they be presented monthly as the work progresses.

Collection of Royalty

To protect the owner against claims for royalties, the engineer, unless prepared to acknowledge them, must see that the method of construction outlined does not involve the use of any patent process, and so entail the collection of monies by the patent owners. On the other hand, should the contractor carry out the work not in accordance with the plans and specifications, and by so doing trespass on any patent rights, the contractor should indemnify the owner against any suits or claims arising, whether it be for method of construction, material or plant.

Order and Progress of Work

The engineer should be given power to direct the commencement of the work at such times and at such places as he may deem necessary to secure its completion within the contract time. The wisdom of this course is apparent when the work and services of different contractors must be co-ordinated during the process of construction.

Disorderly Employees

The engineer's authority over the contractor's staff is a questionable matter. He should, however, specify that the work must be in the hands of a competent foreman satisfactory to himself. This foreman should be constituted the official representative of the con-

tractor and capable of taking instructions from the engineer. Disorderly or manifestly incapable employees should be subject to dismissal upon the request of the engineer.

Public Convenience

It is common to specify that the contractor must not unduly inconvenience the public in the carrying out of the work. Certain diversions for traffic in the case of road work or bridge construction must be arranged. In case of a building, the contractor must be careful as to the piling of new and old materials on public and private property. He should as nearly as possible prosecute the work that no source of inconvenience, complaint or nuisance shall result to the public.

Protection of Monuments or Stakes

The engineer will be wise to provide for the protection of any stakes and bench marks set by himself or his assistants, otherwise careless employees of the contractor may disturb them, with the result of defective work due to errors of elevation and alignment.

Barriers, Lights and Watchmen

The work or structure, while under construction, must be the object of protection by the contractor, and his duty to provide barriers, lights, and if necessary suitable watchmen, must be clearly set forth.

Final Clean-up

That the finished structure may present a neat and finished appearance, the contractor should be instructed to remove all surplus material, debris, false work, appliances and tools before leaving the work.

Specific Clauses of Specifications

The specific clauses deal with the detailed extent and the quality of the materials and workmanship. This portion of the document must be drawn up with particular attention to the work under construction. The following basis of consideration may be made applicable to different types of work, and will be briefly outlined.

1. Extent of the work.
2. Accompanying and contemplated drawings.
3. Dimensions.
4. Capacity or required performance.
5. Description of the different parts of the work.
 - (a) Materials.
 - (b) Workmanship.
 - (c) Method of construction.
 - (d) Inspection.
6. Time of completion.
7. Acceptance tests or guarantees.

Extent of Work

In order that the contractor may bid accurately, it is well to enumerate in order all the important operations involved. If the owner is to provide any materials, it should be clearly stated here. In certain types of work a schedule of quantities is an aid which readily conveys to the contractor a definite idea of the magnitude of the work.

Accompanying and Contemplated Drawings

This clause incorporates the plans into the specifications, and for ease and reference they are suitably listed. If the engineer or contractor is to prepare detail drawings, it should be so stated, and provision

made that these drawings must be approved by the engineer.

Dimensions

There are many limiting facts of a dimensional nature which should for emphasis be inserted in the specification. Among the commoner items are widths and slopes of cuts or fills in grading work, and such items as clear and overhead spans in bridge work.

Capacity or Required Performance

The purpose of this clause varies with the character of the undertaking, if in the case of a bridge, ability to carry certain superimposed loads is specified. Indeed, should the contract call for the building of a machine, the duty or required performance must be clearly stated here, as this condition is the most important factor.

Description of the Different Parts of the Work

This section, with its clauses, is the real body of this division of the contract. It is usually convenient to treat here the parts of the structure in order, and to set forth the quality of materials, workmanship and the method of construction entering into their fabrication to form the finished work. For the convenience of the different tradesmen, it is often wise to describe the material and workmanship under headings corresponding with the different classes of labor involved, such as masonry or carpentering in case of building construction. The quality of common materials are usually specified to comply with recognized standards, as for example, Portland cement may be required to satisfy, according to its properties, the test laid down by the Canadian Engineering Institute. In case of other materials, the engineer must be definite in description, either setting forth a minimum of desirable qualities or a maximum of defects that will render them acceptable. Care should be taken in setting forth methods of construction. If the work is general, as in road building, and only one way is practicable, the engineer should set forth the method in detail. However, in the case of a specialized nature in which the contractor has special experience, he should be allowed some latitude. In the description of each particular class of work, it is frequently necessary to state that continuance requires approval up to that point; thus it is common to specify that forms must be satisfactory to the inspector before any concrete may be placed.

Time of Completion

It is usual to state that time is to be the essence of the contract. If the nature of the work so demands, it is well to state clearly in this connection the date of commencement and completion and perhaps a specified rate of progress. Allowance in days should be made in consequence of unsuitable weather conditions, acts or omissions of the owner, not caused by any fault of the contractor, which delay the prosecution of the work.

Acceptance, Tests or Guarantees

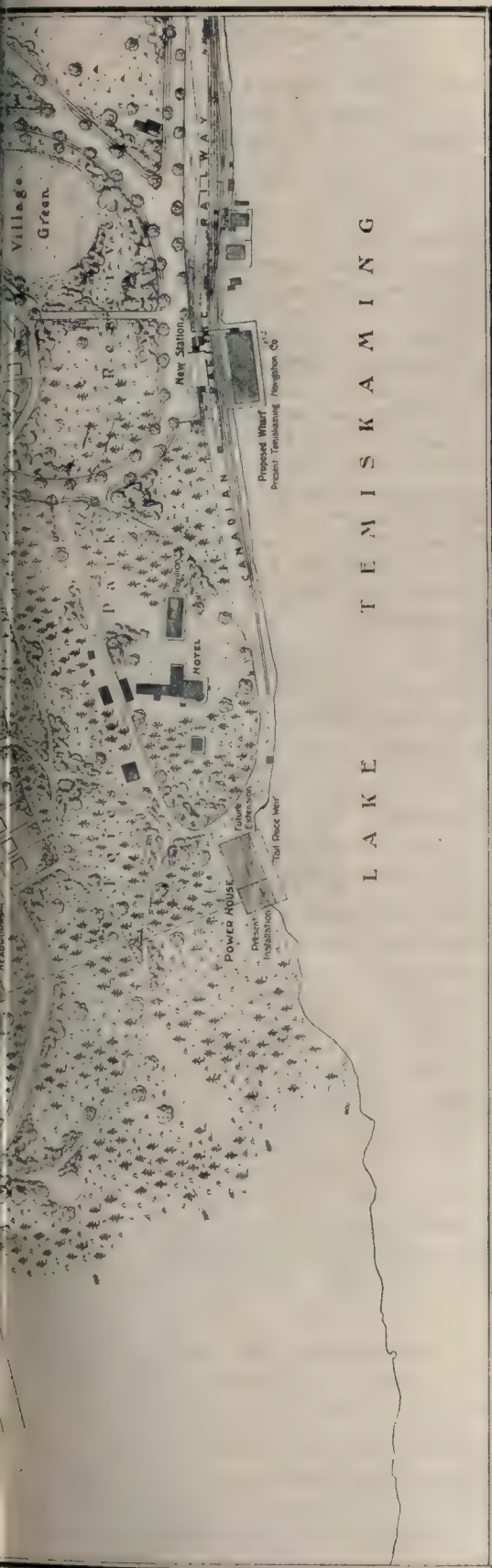
Finally, it is usual to terminate the specific clauses with the provision for an actual test of the structure before acceptance. In case of roads, this clause takes the form of a guarantee of maintenance by the contractor for a prescribed number of years.

The Quebec Government Bill for the construction of Industrial Houses and the loan of the necessary funds has been passed.

Pulp and Paper Company Plan Develo



Plan of Model Town Site at Kipawa, P. Q.



KIPAWA, P.Q., has been adopted as the site for a model community by the Riordan Pulp & Paper Co., in connection with their new mill for the production of pulp. The location at Kipawa has apparently been selected because of the proximity of timber limits and water powers derived from Kipawa Lake. For the purpose of promoting the mill and town, the company has brought under control a compact area of about ten square miles, which is to be developed into a model townsite with the consent and approval of the Quebec Government and the co-operation of the Commission of Conservation, through its town planning adviser, Mr. Thomas Adams.

The accompanying plan of the proposed development, provided through the courtesy of the Commission of Conservation, illustrates the site overlooking Lake Temiskaming, which is part of the Ottawa River. The site of the mill is to be south of the town on the opposite side of Gordon Creek, the stream by which the waters of Kipawa Lake drain into Lake Temiskaming.

Choice of Ground Limited

The choice of a suitable townsite was rendered very limited by the fact that a mill location had been selected to take up nearly all the available level land. Furthermore, physical features, such as Lake Temiskaming, Gordon Creek and the tracks of the C.P.R., were governing factors to be taken into consideration. In addition, at a point to the east of the area shown on the map, there was an existing mill and village, known as Lumsden's Mills, on which side the whole level land was taken up by lumber yards.

The only available land for a town, therefore, was hilly ground to the north and south of the mill site overlooking the lake and river, considerable portions of this land being covered with huge boulders and timber or shrub of various sizes and densities. After a thorough investigation, the location north of the mill site was selected and although apparently a steep hill, was found on inspection to embrace considerable fairly level areas, which might be developed to provide easy grades and economical arrangement of lots, if a proper plan was adopted.

As a first step toward preparing such a plan, a topographical survey was carried out by Messrs. Ewing, Lovelace and Tremblay, of Montreal. While this survey was being carried out, a preliminary sketch plan was prepared. After a consideration of several alternatives, the main lines of the plan illustrated herewith were determined on and surveyors were instructed to locate the roads on the ground. For this purpose, paths had to be blazed through the forest and the plotting carried out under peculiar difficulties, a large part of the work being performed in the heart of winter.

Water Conduit Introduces Difficulties

Considerable care had to be taken to select sites for the churches and other public institutions. Other existing features which had an influence on the plan were the position of the station and the existence of a good hotel overlooking the lake, situated in what can be made a beautiful park. A factor which introduced considerable difficulty was the intention of constructing a water conduit, which is shown to intersect the whole town, for which provision had to be made in carrying out the plan. The only approaches between the small areas of the town on the south of the conduit and the larger area on the north, were to be obtained by bridges over the conduit, which is above ground and 8 ft. in diameter. The grades of the streets, therefore, had to be determined not only with due regard to the contours of the land, but also in relation to the artificial obstruction created by the conduit.

The final arrangement is illustrated and shows the main approach from the station by two curved roads leading to the central square in different directions. The character of the ground made more direct approach impossible. The central square location was

the only level area of any size suitable for the purpose after leaving the low level occupied by the village green. From the central square, there is a main avenue running parallel with the lake and following an easy grade.

Less Than Five Per Cent. Grades

Notwithstanding the steepness of the ground, the contours ranging from 650 to 1,000 ft., the grades of most of the streets are less than 5 per cent. Had the land been laid out in the usual rectangular form, the grades, in some cases, would have amounted to 18 per cent.

The suggestions on the plan show mostly semi-detached houses, with a few individual houses and some groups of three to six of the smaller types. Care has been taken to give the residences a good aspect, with ample air space and open surroundings for each house. Messrs. Ross & McDonald, of Montreal, have been entrusted with the design of the houses, the first of which have been erected. It is expected that a large number will be constructed shortly and that the mill will be completed and in operation. The architects are permitted to use their discretion with regard to the grouping, sizes and location of the houses, but will adhere to the plan so far as the location of streets is concerned, and will not diverge from the determined arrangement of public buildings.

After the plans had been prepared, consideration was given to the problem of water supply and drainage, and after consultation with Messrs. R. S. and W. S. Lea, Montreal, it was found that no readjustment of the plan was necessary to enable an economical system to be designed.

A town manager and engineer has been appointed to assist in the promotion and development of this town-site as a model community.

Water Softening Plant

THE following details gathered from a paper by E. V. Chambers, of the Society of Dyers and Colourists, are of general interest.

Water softening being a chemical operation, the factors of proportion, time, and temperature apply, and practical experience serves to show the many difficulties to be overcome. A great deal depends upon the selection of the proper type of plant for the work in hand, and when the water exceeds a moderate hardness the lime and soda type becomes a necessity. This type of plant, when properly designed and with due attention, will give satisfactory results.

There are two general types of lime-soda water softening plants—the intermittent and the continuous types. The intermittent type possesses several advantages. This plant usually consists of two large tanks, each tank holding at least four hours' supply of water. The process works intermittently, so that when one tank of water is being softened the other tank is being filled with hard water. The volume of water in the tank is known, and to this measured volume of water of known hardness a weighed quantity of lime and soda is added—the lime in the form of milk of lime and the soda in solution form. The contents of the tank are then thoroughly mixed and allowed to settle. After a certain time the calcium and magnesium compounds are precipitated, settling to the bottom of the tank. The clear softened water may then be drawn off

for direct use or into a store tank and the precipitated solids drawn off by an outlet in the bottom of the tank.

Owing to the facilities for control, this is probably the most exact method of water softening, and, with an ordinary hard water, practically the whole of the hardness forming salts can be removed, and, the softened water contains the minimum excess of lime and soda. In a works where there is sufficient room for tanks, and first cost is not an essential, it forms probably the most satisfactory plant.

The continuous process plant, taking less room and needing less attention, has received more attention. For successful working it must conform to the following conditions:

(1) The lime and soda control system must work accurately.

(2) The tank capacity must be large enough to enable the chemical reaction to complete itself fully.

(3) The lime and magnesia sludge must be easily removed from the plant.

A suitable type of plant to deal with 5,000 gallons of water an hour, has a tank of 15,000 gallons capacity and of dimensions 34 feet in height and 10 feet in diameter. Lime and soda for one day's charge are placed respectively into the reagent mixing tank and the lime slaking tank. After being mixed with water the lime and soda solutions are elevated by steam ejectors to the top of the plant. The soda enters the reagent reserve tank and is fed from there by a ball valve into the reagent feed tank, where it is kept at a constant level. The milk of lime gravitates by the central pipe into the bottom of the lime saturator. The hard water is pumped into the hard water receiving tank, and flows through two slot pipes, one of the lime saturator and one to the main treatment tank. The slot pipe controlling the feed of the lime saturator is adjustable, and is set to displace the exact amount of lime required for the treatment, which is fed into the main treatment tank, at one constant strength, being in the form of a saturated solution of lime.

Should the flow of hard water vary, its level will rise or fall in the hard water receiving tank, thus passing more or less water through the slot to the lime saturator. At the same time the float in the hard water receiving tank will rise or fall actuating the lever and dipping another slot pipe more or less into the soda. The soda slot pipe is also adjustable, and is set to feed the exact quantity of soda required to treat the hard water. The lime and soda thus apportioned are thoroughly mixed with the hard water in the central tube of the main clearing tank, where ample time is allowed for the chemical action to complete itself. The cleared water passes slowly upwards through the wood fibre filter when the water is ready for use. The precipitated hardness forming salts are drawn off by the sludge valve at the bottom of the tank, which has a conical bottom with an angle of 60 degrees to facilitate the removal of all the sludge. The spent lime in the saturator is also drawn off in a similar manner once a day.

It will be seen by the foregoing description that the only moving parts in the whole of the plant are the lever which is actuated by the float, and the ball valve which controls the soda level in the reagent feed tank. There is therefore little to wear or get out of order, and the plant can reduce a water having a total hardness of 26 degrees down to 2.5 degrees without any appreciable excess of alkalinity at an approximate cost of 5 cents per 1,000.

Storage of Coal and Spontaneous Combustion

By S. H. Pudney*

THE storage of coal is a subject worthy of everyone's attention these days. It is something that vitally interests those who of necessity, store coal for future use. There are hundreds of companies storing coal who never considered such a thing a few years ago. This is no doubt due to reasons that we are too well acquainted with to need much mention here. The war, shortage of labor and transportation are the chief reasons.

There are certain liabilities and risks run in the storage of coal, such as weathering, heating, even up to the point of fire, wastage in storage due to the layout of the ground, wastage and expense in unloading, wastage and expense in picking up again, all of which materially affect the cost of the fuel when used.

Some writers have claimed a large percentage of loss due to weathering; in fact, one prominent German—fifty years ago—said that it meant a 50 per cent. loss of the fuel. This was like a good many of the extravagant ideas of the Germans, but it was the cause of others going into the matter with a view of finding out how much loss did occur during storage. Through a series of tests, it has been found that a very small percentage is lost; and, in fact, that most of the loss occurs during the first two weeks after the coal is mined, and that this loss is mostly due to the dissipation of gases that are contained in the coal the same as water is contained in a sponge. These are called gases of occlusion. As to other losses due to weathering of the coal they are very small and from our own experience we find that coal taken from storage piles gives better service than new mined coal. At one time, our Angus Shops burned screenings on their chain grates taken from our dumps and got good results, but in the spring, as soon as the new coal came along they experienced great trouble with clinkering fires and this with coal from the same mines as the dump coal. This is a feature that is very noticeable in storage coal; even coals that are especially liable to clinker lose some of this property in storage, which is due to the mineral elements in the ash becoming oxidized and preventing clinker formation.

Under Water Storage

The storage of coal under water has been advocated by some, but this is impracticable in this climate, and it is doubtful if the efficiency gained would begin to cover the costs of installation of such storage plant, even in a warmer climate. Some favor storage of coal in small quantities to prevent overheating, this could not be entertained by railways and others using large quantities because the cost of storing in small piles and picking up again would make it prohibitive, and this system would have no protection against fires, as I have often found them within a few feet of the outside of the pile.

There is also a difference of opinion as to the right depth to store coal, but most coal will stand about 12 to 16 feet. I would much rather have the responsibility of one pile with 100,000 tons in it than five piles of 20,000 tons in them. I do not consider the danger any greater. A storage ground should be as nearly

level as possible or better still, with a gentle slope. A turf ground makes a good bottom and very little loss occurs when the coal is picked up again from such a ground.

Spontaneous Combustion of Coal

This is something which gives a lot of trouble at times, and generally speaking, is a subject that is very little understood by the ordinary laymen. This is not to be wondered at when higher authorities who have made tests to determine its cause, together with scientists, differ so much in their views. One can hardly wonder that the layman without a knowledge of chemistry, and oftentimes with very little practical experience, understands so very little about the cause of spontaneous combustion. Also as a rule, he understands very little as to the most practical manner of attacking a fire after it has started; this is mostly due to lack of knowledge of the science of combustion.

In the first place, it would be as well to consider the cause of spontaneous combustion, and to do this, it is necessary to bring into the paper what some of the higher authorities have to say on this. Several investigations have been made by very eminent men, with a view to finding just what is the cause of it, but so far, not much practical knowledge has been given to the world at large. I do not think that any one with a very large pile of coal on his hands, nearing the point of fire, could get anything out of most of these reports of tests that would be of any benefit to him, and very little information could be obtained from them that would help him to prevent a fire. This is because these investigations have been made with small samples and under special conditions that do not obtain in ordinary practice. The testing of a small sample of a few grams of coal, powdered to an extreme fineness, and subjected to an atmosphere of pure oxygen, does not convey the least idea of what occurs in a pile of coal of 100,000 tons, containing all sizes and under all atmospheric conditions.

Cause of Fire

There has been a great difference of opinion as to the cause of fire in coal piles during the last fifty years, and there is still the same difference to-day. For instance, some authorities say that sulphur has very little to do with it, if anything at all; again, others say that it has. Others say that the percentage of volatile matter has a great deal to do with it, and that coals very high in V. C. M. are more liable to fire than coals with a low percentage of V. C. M. Others say that the carbon content of the coal is the predominating feature.

After a good many years of practical experience, and with some knowledge of chemistry, I have come to a sort of theory; and I have yet to find anything to disprove or convince me that I am wrong. This has come about by close investigation into every fire that I have seen and studied in its various stages from heating, up to the point of actual fire, and these I propose to give in this paper with the hope that they will be of service.

I will take up the sulphur first. Despite the fact that its influence on spontaneous combustion is disputed, I am of the opinion that it is the element of greatest danger in the storing of coal. By the word Sulphur, I do not include that known as sulphur balls, or true metallic pyrites. The sulphur in this form is very slow in its chemical changes, and not enough

*Fuel Inspector, C.P.R., before the Canadian Railway Club

heat would be set up during this change, in a given time, to do any harm to a coal pile; in fact it would disperse as fast as generated without being noticed. There are other forms of sulphur in coal which are dangerous and the most vital one is that where the bone coal, and small pieces of shale, are full of sulphur. In this form it very easily becomes oxidised, even if out in the open air. It is only a matter of a few days before one will see the sulphur cropping out all over these pieces, like a fungus growth, whitish in color. At any place near where the coal is heating, to such an extent that fire is expected to show up, this is so extensive, that in some places the surface of the coal pile is covered with sulphur out-croppings, that has through oxidation and moisture, been brought to the surface. This is more noticeable in some coals than others, and my experience is that these are the coals that are liable to spontaneous combustion.

With our system of ventilation we often find some of the holes choked completely with sulphur, so that it is impossible to put down our test rods until the holes have been remade. In one place where heat had set up to such a degree that the coal had reached the stage of autogenous oxidation, we had the coal dug out and found that though actual fire had not started, the heat had so far advanced that destructive distillation had begun, and gases were being liberated from the coal even from the centre of large lumps. Here, I found the coal surrounding the actual hot place, full of these small pieces of shale and bone yellow with sulphur, and an analysis showed 6.7 per cent. of sulphur, while the average run of sulphur in this coal was less than 2 per cent. There is no doubt in my mind as to what was the cause of the coal in this spot heating, and in several more spots in the same pile I found the same conditions, and as this pile was heating in spots and not regularly all over the pile, no one who had seen this pile and the conditions that prevailed, could have arrived at any other conclusion than that the sulphur was the direct cause of the heating. However, the presence of sulphur in coal cannot be controlled as well these days as formerly, due to the labor conditions. Coal is not picked quite so clean as in former years, which is the reason that more fires have occurred lately.

The liability of spontaneous combustion due to a greater percentage of V. C. M. in the coal, does not hold water for one moment in actual practice; there are now quite a number of authorities who disclaim this feature. I gathered this knowledge from the fact that some of the coal we were handling easily caught fire with 35 per cent. of V. C. M., while others with over 40 per cent. did not have the slightest tendency to heat up, and the peculiar part of it is that they had about the same percentage of sulphur, but that it was in a different form. Some authorities are of the opinion that spontaneous combustion is caused directly by the slow oxidation of the carbon content of the coal, and that the sulphur is only a secondary matter. If they were correct in such a statement, then we would be up against the proposition that all coal piles would be equally liable to catch fire, because all coal is chiefly composed of carbon, and its oxidation would be practically constant in all coal. Everyone that has had to do with storage of coal knows that some coals are more liable to heating than others, and this fact proves to the contrary the oxidation of the carbon theory. From my own actual practice, I am able to state that any fire that I have found has been caused

by sulphur and not by oxidation and carbon. In places that have been dug out where the coal has been so hot that one could not hold it in the hand, but had to hold it in a scoop to examine it, I found that the structure of the coal had not changed and was the same as when it was put in the pile, and yet there was bluish gas emanating from the piece of coal being examined. Now, if it had been oxidation of the carbon of the coal, which had caused the heat to set up, the structure of the coal would have been changed considerably before this amount of heat had obtained, while, on the other hand, one was to take a lump of coal and place it in an oven and heat to about 300 degrees and keep it there at that temperature, the same thing would be found, that the coal would be giving off a gas. In other words, destructive distillation would be started, and this would be found to be not from the oxidation of the carbon content of the coal, but from the outside heat to which such coal had been subjected.

My own personal opinion is that sulphur is responsible for the trouble in coal piles. I feel that its rapid action in chemical changes is governed by the form in which it is contained in the coal. The power of fresh mined coal to absorb oxygen is well known, but there is doubt that the oxygen is contained in the coal, the same as water is contained in a sponge, and is a gas of occlusion and not chemically combined with the coal itself but held mechanically, and is given up to any chemical change that may occur which, in this case, is oxidation of the sulphur. The sulphur starts to oxidize, and in this action a certain amount of heat is generated. This heat again in turn increases the chemical energy, the increase in chemical energy raising the temperature. These changes dovetail into one another gradually, until sufficient heat is generated to start destructive distillation of the coal at the same time. At this temperature, the coal is hot enough to start self oxidation, or in other words, the stage of autogenous oxidation is reached. It is then only a matter of a few days till actual fire occurs with coking of the coal.

One of the bad features in building coal piles and which we have found helps a lot towards spontaneous combustion, is when one is obliged to stop building the pile for any cause, leaving the face of the pile of fresh mined coal exposed to the influence of the sun and the atmosphere. In this way, it becomes loaded with oxygen and as soon as new coal is unloaded on top of it, the oxygen is given up in the chemical change that goes on with the sulphur and one may expect trouble from the part of the pile; in fact, we get it without expecting. Prevention is much better than cure in this case and coal piles should be ventilated if possible. The system in vogue on the C. P. R. we consider second to none.

The idea of where the benefit of ventilation comes in is rather vague to some, and one could get a dozen different views of it from as many men as handle coal, but the real benefit lies in the fact that when a coal pile is ventilated, it gives an opportunity for the heat to become dissipated. Coal usually has plenty of moisture in it, especially when unloaded in wet weather. The consequence is that as heat is mechanical energy, once it occurs we see its effect by the vapor coming out of the vent holes; all of this steam or vapor requires a given amount of energy to vaporize it, this then, is using up the heat that is being generated, and while this keeps up there is very little danger of fire.

Some imagine that a system of ventilation allows the

gases to escape, but as there are no gases to escape until the coal has reached nearly the point of fire, this cannot be right. Our experience is that with coal wet or even fairly moist and ventilated there is no danger at all.

There seems to be no set rules for fighting a fire, nor do I think there could be, because conditions are not always alike, but a few suggestions as what not to do may not be amiss. Fires in a coal pile bury very slow, for the simple reason that not enough air can reach the fire for rapid combustion. Therefore, never open up a fire spot. If the place is to be dug, dig close around it without touching the fire. Isolate it from the rest of the pile, then dig it out completely and drench it with water. It is one of the hardest things to prevent the inexperienced from opening up a fire. Fire will spread rapidly if opened up. Another thing very important, is that in using water on a coal fire, always saturate the coal surrounding the fire spot before putting water on the fire. If this is not done, the fire will be forced away from one faster than it can be reached. The reason for this is that the water going on to the actual fire, forces the heat into the surrounding coal which is nearly to the point of fire already, and at the same time it forms coke on the surface of the fire, into which it is impossible to force any more water, and meanwhile, the fire is still going ahead. It is absolutely ruinous to the rest of the pile to play water directly on to the fire, before putting a water screen around the outside of the fire spot first. It is very seldom that a direct application of water will put out a coal fire; and yet, I have put out a great many fires by application of water, after using the proper precautions, that is to say, by putting a water screen around the actual fire spot. At one time, with the assistance of two men, I put out a fire that measured 350 by 50 feet at its widest point, and which would have practically gone through the 80,000 ton pile if it had not been stopped. This was done by finding the exact outer limits of the fire, then digging a shallow trench right along outside using water freely so as to put the water on the outside of the fire, then by systematically digging a relay of trenches coming nearer to the fire all the time we drove it to the outside of the pile and killed it completely. I might say that there was solid coke found to be six feet thick in this fire area, and the balance of the pile did not have to be touched.

Our mode of attacking a fire is to get our test rods out around the spot and find out the exact dimensions of it, then find at what depth it is. We then dig a trench around this spot, making sure to keep outside of the fire spot, saturate this with water and make holes with rods and see that a complete water screen is put around the fire, then, by a series of trenches gradually working nearer to the fire; we reduce this area until we cover the exact spot where the fire is, and making holes with our rods we take care to well flood it with water, and it is very seldom we have to return to the spot as it is usually completely extinguished.

The plastering contractors' section of the Toronto Builders' Exchange, at a recent conference with the union representatives, agreed upon the establishment of a wage of 70c an hour, to be effective from May 1 next to May 1, 1920. For the year following that, May 1, 1920, to May 1, 1921, the rate of pay is to be 75c an hour, under the same agreement.

Building Figures for February

Estimated Cost of Building Work as Indicated by Building Permits Issued in Thirty-Five Cities

City	February, 1919	February, 1918	February, 1919, compared with February, 1918	
			Increase (%)	Decrease (%)
			Amount	Per cent.
Nova Scotia	\$265,133	\$71,584	*\$193,549	* 270.33
Halifax	250,248	68,075	* 182,173	* 267.61
Sydney	14,885	3,509	* 11,376	* 324.19
New Brunswick	39,300		* 39,300	
Moncton	26,550		* 26,550	
St. John	12,750		* 12,750	
Quebec	320,170	134,692	* 185,478	* 137.71
Montreal-Maisonneuve	151,740	77,045	* 74,695	* 96.95
Quebec	53,630	25,147	* 28,483	* 113.27
Sherbrooke	90,000		* 90,000	
Three Rivers	24,800	17,000	* 7,800	* 45.88
Westmount		15,500	† 15,500	
Ontario	1,024,499	492,942	* 531,557	* 107.833
Brantford	4,275	10,000	† 5,725	† 57.25
Fort William	4,550		* 4,550	
Guelph	4,885	2,800	* 2,085	* 74.46
Hamilton	189,965	65,890	* 124,075	* 188.31
Kingston	11,312		* 11,312	
Kitchener	2,660	425	* 2,235	* 525.88
London	41,795	16,560	* 25,235	* 152.39
Ottawa	20,300	15,800	* 4,500	* 28.48
Peterborough	21,350	1,230	* 20,120	* 1,635.77
Port Arthur	322	530	† 208	† 39.25
Stratford	5,245	575	* 4,670	* 812.17
St. Catharines	18,140	8,125	* 10,015	* 123.26
St. Thomas	7,665	550	* 7,115	* 1,293.64
Toronto	676,185	347,282	* 328,903	* 94.71
Windsor	15,850	23,175	† 7,325	† 31.61
Manitoba	25,250	54,900	† 29,650	† 54.01
Brandon	4,600	250	* 4,350	* 1,740.00
Winnipeg	20,650	54,650	† 34,000	† 62.21
Saskatchewan	45,425	28,125	* 17,300	* 61.51
Moose Jaw	1,625	17,500	† 15,875	† 970.71
Regina	37,600	3,650	* 33,950	* 930.14
Saskatoon	6,200	6,975	† 775	† 11.11
Alberta	50,700	47,850	* 2,850	* 5.96
Calgary	47,500	32,200	* 15,300	* 47.52
Edmonton	3,200	15,650	† 12,450	† 79.55
British Columbia	92,989	71,190	* 21,795	* 30.62
New Westminster	17,075	3,900	* 13,175	* 337.82
Victoria	10,100	11,875	† 1,775	† 14.95
Vancouver	65,810	55,415	* 10,395	* 18.76
Total—35 cities	\$1,863,462	\$901,283	*\$962,179	* 106.75

New Power House

The Public Works Department proposes to construct a power house and laundry in connection with the Military Hospital Building at Lake Edward, P. Q. It will consist of a basement and one storey, with concrete foundations. The basement will contain coal bunkers in the rear, engine, dynamo, pump rooms and workshop at the right hand side, the central portion being used for the laundry. The dynamo room is to be separated from the pump room by a 9-in. brick wall, and the laundry will be cut off from the other section by 14-in. brick walls. The first floor will contain another portion of the laundry, including the disinfection room, with stores and toilets. A high brick chimney is also to be erected, having a cast iron cap. The foundation walls and beams, including the chimney foundation, are to be of concrete. The boilers are to be carried on girders supported by concrete piers.

The floors of the boiler room, bunker, engine and dynamo room, and pump house will be of 4½-in. concrete, with a wearing surface 1½ inch thick. The floor and laundry roof over the bunkers will be of reinforced concrete. The main floor is to be covered with asbestos shingles, and the roof of the other portion with tar and gravel.

The power plant will consist of a 20 k.w. 125 v.d.c. generator multipolar type, direct connected to a steam engine. The panel board is to be of the double branch type. The system of wiring will be designed for the parallel two wire 110 v. d.c. interior conduit system.

Meter Practices of the Hackensack Water Company

By D. W. French

WHEN water meters are first purchased by the Hackensack Water Co. a record of test is required from the manufacturer of the $\frac{1}{2}$, $\frac{3}{4}$, 1 and 2-in. sizes as follows: a 10 cu. ft. test on full flow, a 10 cu. ft. test on a $\frac{1}{2}$ -in. stream, and a 0.1 cu. ft. test on a 1-32-in. stream. The complete test for a 3-in. meter is a 10 cu. ft. test on full flow, a 10 cu. ft. test on $\frac{1}{4}$ -in. stream, a 10 cu. ft. test on $\frac{1}{8}$ -in. stream, and a 0.1 cu. ft. test on 1-16-in. stream. The complete test for a 4-in. meter is a 100 cu. ft. test on full flow, a 100 cu. ft. test on 1-in. stream, a 10 cu. ft. test on $\frac{1}{4}$ -in. stream, and a 10 cu. ft. test on $\frac{1}{8}$ -in. stream. For a 6-in. meter the tests are a 100 cu. ft. test on full flow, a 100 cu. ft. test on 1-in. stream, a 10 cu. ft. test on $\frac{1}{4}$ -in. stream, and a 10 cu. ft. test on 5-32-in. stream. For an 8-in. meter the tests are a 100 cu. ft. test on full flow, a 100 cu. ft. test on 4-in. stream, a 100 cu. ft. test on 2-in. stream, a 100 cu. ft. test on 1-in. stream, and a 100 cu. ft. test on $\frac{1}{2}$ -in. stream.

The records of all tests include the change gears used with each and every meter. Before the $\frac{1}{2}$ -, $\frac{3}{4}$ - or 1-in. go into service, a separate test is made by the water company, and no meters of these sizes are installed which do not show an inaccuracy of from 1 to 2 per cent against the water company. The $\frac{1}{2}$ -, $\frac{3}{4}$ - and 1-in. meters are also subjected to a water pressure test of 350 pounds per square inch by means of a hand pump.

In making tests often required by customers because of high bills, such meters are considered accurate if tests show them to be within 2 per cent either way.

The author feels that he cannot emphasize too strongly the importance of testing carefully all meters which have been frozen. His experience has been in scores of cases that the disc chambers or, in the rotary piston type of meters, the top head of bottom plate, or possibly both parts, were so badly sprung that merely replacing the bottom casting does not restore accurate registration. It is agreed that because a meter freezes this does not belittle it in any way, although it may cost more to repair some makes than others. Yet there is no good reason why meters can not be protected from frost and freezing is almost invariably due to lack of consideration or negligence, in either of which cause the expense of repairs should be borne by the owner of the premises.

Meter Setting

All meters used in connection with the Hackensack system are owned and kept in repair by the company, except in cases of misuse or freezing, when a deposit is required to cover the cost of repairs. After this cost is known the balance is returned to the owner of the premises.

Prior to Jan. 1, 1918, applications for service were made by about 200 plumbers licensed by the water company. After the service was installed and the building was ready for occupancy, the meter was delivered to the plumber and set by him. Since Jan. 1, 1918, the water company has been setting all meters and the plumbers no longer have anything to do with this part of the work. When the meter is set, a shut-cock is placed on each side of it and a check valve is

also located on the house side of the meter, which acts as a protection to the meter as well as a protection to the property of the owner, should a break occur in the street main.

Only a small percentage of the meters are set in outside meter boxes, and such settings are confined almost entirely to manufacturing plants and private fire lines. Suitable concrete boxes are required for such outside settings, and built at the expense of the applicant.

In manufacturing plants, where the use of water is large and often lasts for the full 24 hours, the company has found it advantageous, both to the consumer and itself, to install the meters in batteries, which, of course, adds to the expense, but enables examinations, repairs or changes to be made without interruption to the service.

Meter Reading

All meters on the system, of which there are about 45,000 in use, are read and billed quarterly, except about 300 in sizes between $1\frac{1}{2}$ and 10 in., which are read and billed monthly. Meters registering more than 25,000 cu. ft. per month are included in the monthly survey. All meters in the monthly survey are read on the last day of the month, provided it does not fall on Sunday or a holiday, in which event readings are made on the following day.

In reading the quarterly meters, the districts are divided into block and working lumbers. Each inspector's territory covers about 3,500 meters, and he reads, on an average, about 175 meters per day. The quarterly readings begin on the first day of the last month in the quarter, and must be completed not later than the 20th.

Each man starts out with about 200 cards on which readings are entered, and each card, by using both sides, provides for such quarterly readings for a period of four years. These cards are turned in again in the afternoon, together with any and all complaints, such as meters not working, broken glasses, meters leaking, etc., all of which receive attention on the following day. Printed cards are also mailed on the day following the reading to all customers where the meter shows an increased or unusual consumption. The reading cards are then used in making out the quarterly bills.

By repeating this operation each day during the reading period, it is plain that on the day following the last reading day, all defective-reading meters have been changed, that the many various small complaints have been attended to, that the bills have been made out, and there has been ample time for comparisons, checking etc., before the end of the month. During recent years the company has not failed in getting into the mail during the last day of the quarter the entire survey bills, which are then in the hands of its customers on the first day of the following quarter.

Collection of Bills, Etc.

Promptly after the bills reach the customers, payments begin to come in, and an accurate record and report of collections is made by each district office and tabulated at the main office, showing each morning the sum of money collected in each district and its percentage relation to the survey.

In following any such plan, an excellent opportunity is afforded for comparing the work of the various collectors.

During the recent years the records show that about 65 per cent of the total surveys are collected

*From a paper before the New York Section of the American Water works Association.

during the first 30 days, and from 26 to 30 per cent during the second 30 day period.

Maintenance of Meters

For many years the Hackensack Water Co. has been following the practice initiated in the early nineties of removing for test and a general going over, the various sizes of meters after having registered a fixed quantity of water and regardless of the length of time required to reach these quantities. The practical result is that every meter installed on the system comes into the shop at about uniform intervals for a general overhauling. After examination, repair, test and painting, the meter is returned to stock and is ready for another period of use. Following this practice, a very small percentage of meters break down, and the author is sure that a higher degree of efficiency is maintained between the intervals of fixed registration.

For more than 20 years the company kept up its original plan of making these changes, as follows: Change all $\frac{1}{2}$ -in. meters after registering 100,000 cu. ft.; change all $\frac{3}{4}$ -in. meters after registering 250,000 cu. ft.; change all 1-in. meters after registering 500,000 cu. ft.; change all 2-in. meters after registering 2,000,000 cu. ft. In sizes above $\frac{1}{2}$ -in. records were kept of all examinations, including examinations of intermediates, and changes were made when it was deemed necessary.

All such changes are now made under the rules, regulations and recommendations of the Board of Public Utility Commissioners for the state of New Jersey, which are as follows: Change $\frac{1}{2}$ -in. meters each 10 years, or after registering 750,000 cu. ft.; change $\frac{3}{4}$ -in. meters each 8 years, or after registering 1,000,000 cu. ft.; change 1-in. meters each 6 years, or after registering 2,000,000 cu. ft.; change all meters larger than 1-in. each 4 years.

All work in connection with the testing, repair or maintenance of the meters is performed in the water company's shop, which is complete with up-to-date tools and modern testing equipment, and seven or eight men are steadily engaged on this work.

A.M.B. & C.I. Board Meets

AT a meeting of Board of Directors of the Association of Montreal Building and Construction Industries held last week, Mr. W. M. Irving in the chair, the secretary submitted correspondence with the Department of Public Works, and the Department of Soldiers' Civil Reestablishment, Ottawa, regarding alteration work being executed at the Military Hospital, 68 Drummond Street, Montreal, and it was decided to interview Senator Sir James A. Loughheed on the matter. A letter from one of the members was submitted urging that the Association request the Minister of Public Works to place the contract for the completion of the Laprairie Dyke in the hands of competent engineering contractors. The letter concluded "This road has been a political football since 1912. The contract has been let in turn to a grocer, a butcher, and candlestick maker, then continued with day labor, then placed in the hands of a contracting firm who were financially unable to continue, and later placed in the hands of Messrs. Quinlan & Robertson, and finally taken out of those competent hands for the purpose, we believe, of completing it by day labor. From present appearances the comple-

tion of this work will never come." The secretary was instructed to ask the Minister of Public Works, Ottawa, what his intentions in the matter were.

Recent Publications

Chlorination of Water—by Joseph Race, F. I. C., city bacteriologist, and chemist, Ottawa; John Wiley & Sons, Inc., New York, Publishers; price \$1.50, net. In this volume the author has collected and co-related the information hitherto scattered in various journals and treatises on the subject of water chlorination. The various aspects and methods of chlorination are discussed and suggestions made which will doubtless stimulate research work in this fertile field of science. This method of treating water, which was practically unknown fifteen years ago, has advanced in popularity and effectiveness alike to a marked degree, as shown by the fact that, in 1918, over 40 millions of people were supplied with chlorinated water. Indeed it may be truthfully said that no other sanitary measure has accomplished so much at so small a cost and that civilization owes a deep debt of gratitude to the pioneers in municipal water chlorination. The scope of the work may be judged from the following chapter headings: Historical; Modus operandi; Dosage; Bacteria surviving chlorination; Complaints; Bleach treatment; Liquid chlorine; Electrolytic chlorine and Hypochlorites; Chloramine; Results obtained. One hundred and fifty pages, illustrated; red cloth binding; approximately 5 x 8 inches.

Mainly Constructional

East and West—From Coast to Coast

The building permits issued in Point Grey, B. C., during February amounted to a value of \$23,320.

It is reported that fairly extensive school building is planned by the various school commissions throughout the West.

The building permits issued in Regina, Sask., during February are valued at \$37,300, which is a far larger figure than for the same month of the preceding year.

The estimates passed by the Board of Works of Peterboro, Ont., provide for a total expenditure of \$39,400, an increase of \$4,400 over last year's expenditure.

Proposals are being considered in Saskatoon for the establishment of a new normal school at an initial expenditure of \$300,000, the estimated ultimate cost to be \$1,000,000.

Work has been started on the new plant of Gunn's Limited, at West Toronto. The cost of this project will be from \$500,000 to \$700,000.

A by-law has been passed in Hespeler, Ont., adopting the provincial government's housing scheme, and providing for the appointment of a commission. Application has already been made for a loan of \$50,000.

Representatives of the city of St. John, N. B., have been in touch with the government regarding the taking over of the harbor, and it is understood that the Minister of Public Works, Hon. F. B. Carvell, will submit an offer in writing.

It is reported that the provincial government will commence work on the Pacific Highway from New Westminster to Blaine this year, and that part of the cost will be borne by the Dominion Government. The cost is estimated at \$400,000.

The Vancouver Portland Cement Co., Ltd., it is understood, is amalgamating with the Associated Cement Company

(Canada) Limited, which is backed by English interests, and the consolidated concerns will carry on business under the name of "British Columbia Cement Company, Limited."

Complementary to the English Channel tunnel scheme is a proposal to construct a tunnel under Bering Strait, connecting Siberia with Alaska, and thus making it possible to take a thorough train journey from London to Canada, the United States and South America.

The H. H. Robertson Co. of Canada, which is capitalized at \$200,000, has purchased the plant of the Sarnia Metal Products Co., at Sarnia, and plans to commence operations about May 1st on the manufacture of asbestos covered steel roofing and siding, also ventilators, gutter down pipes, skylights and asphalt paint.

The Toronto Structural Steel Company has accepted an offer of \$150,000 for its land and buildings with certain fixtures. The Ontario Investments, Limited is taking over the remaining assets of the concern for \$165,000 in cash and the assumption of all liabilities. The Structural Steel Co. has not paid preferred dividends since June, 1914..

A housing committee has recently been appointed in Regina, Sask., by the Regina Social Service Council. A co-operative house building association is suggested as one means of solving the housing problem, and the building at wholesale prices of anywhere from 100 to 200 private residences has been outlined as an objective.

The new Union Station in Toronto is to be ready for use not later than August, according to the statement made by Mr. Ambrose, Chief Engineer of the Toronto Terminal Railways. The scaffolding is to be taken down within the next few weeks, and after that the building will require only a little finishing work.

In the architects' competition in connection with the proposed building for the Jewish orphanage board, the Manitoba Association of Architects announce that Woodman & Cubbidge take first place; A. Melville, second and W. P. Watson, third. The board will decide as to which of the three firms will supervise the work, which is to cost \$60,000.

Construction of a branch railway line from Lanigan to Humboldt, Sask., and thence northwesterly in the direction of Prince Albert, is being considered by C. P. R. executives. A delegation from Humboldt petitioned for this extension and received a promise that the proposal would be fully investigated.

The additions to the Ontario Agricultural College at Guelph, Ont., will cost close to a quarter of a million dollars and will include the following: A new boys' dormitory, \$150,000; addition to Macdonald Hall, \$25,000; new apiary building, \$15,000; a memorial hall in memory of the O.A.C. students killed during the war, \$40,000.

City Engineer L. M. Jones, of Port Arthur, Ont., has plans under way for the development of the city's water front. The whole arrangement has not yet been decided upon, but the proposition, generally, is a development of the trackage, whereby all railroads can secure access to the properties on the water front, which are to be improved and served by dredging of slips for steamship approach.

Norfolk County Council has determined its programme of road building under the Ontario Highways Act for the next ten years. It has been decided to build the provincial-county roads first. Work will be carried on simultaneously on the highways from Simcoe to Port Dover and Tilsonburg to Simcoe, through Delhi, it being the intention to complete this work during the coming summer.

Work to be undertaken by the C. P. R. in its New Brunswick district includes the replacement of 45 miles of rails between St. John and Megantic on the main line. The trestle

bridge at Newburg Junction, north of Woodstock, will be taken out and a 12-foot concrete arch put in its place. The company also plans to erect a number of residences for its officials and employees.

The Continental Oil Co., according to report, has decided to make Saskatoon its headquarters for northern Saskatchewan, having secured location for a filling station and offices. The company recently announced their intention of erecting a million dollar plant in Regina, and a large new warehouse and 30,000 gallons tankage is also to be allotted to Prince Albert, while the tankage at Saskatoon will be increased.

The Ottawa Gas Company has made an issue of \$850,000 sinking fund gold bonds, maturing in 20 years, for the purpose of providing sufficient funds to complete the construction of its new water gas pipe, which has a capacity of 1,000,000 cubic feet per day. The new plant will be completed in approximately 90 days and when it is finished the total capacity of the company's installation will be 90,000,000 cubic feet per annum.

For the purpose of facilitating the settlement of soldiers in the Prince Albert land district in Saskatchewan, the suggestion has been made that light railways be used to open a large block of townships of excellent land at present fully 60 miles from a railroad. These townships are to be reserved for soldier settlement only and an effort will be made to get 200 miles of light railway from France for use in this and similar districts.

Ontario county council has decided to make an expenditure of \$60,000 this season for "Good Roads" purposes. It is proposed to spend \$12,000 on the construction of provincial-county roads, of which the county's share will be \$4,800, and on maintenance \$8,000, of which the county's share will be \$3,200. For county road construction the province will contribute \$4,800 and the county \$7,200, making a total of \$12,000; and on maintenance \$13,400 will be spent, contributed in the same proportions. An expenditure of \$9,230 is proposed for machinery.

Loew's Theatre Co. have asked the Toronto City Council for permission to construct an arch to connect the \$250,000 theatre which they propose building just south of Bloor St., with Yonge St. The proposed arch 24 ft. wide, is to be erected across a lane which lies between Yonge and Balmuto St., and will have a clearance of 14 ft. above the lane. The entrance to the theatre to be 148 ft. south of Bloor. A provision in the municipal act allows for such arches, and the permit will be granted if the company meets all the standards required by the city.

The building permits issued in the city of Vancouver during the month of February this year show a substantial increase over the same month in 1918, the figures being, respectively, 72 permits, at a value of \$65,810, and 45 permits at a value of \$55,415. The total for the first two months of the year is 142 permits, valued at \$144,007, as compared with 102 valued at \$108,540 in the corresponding period of 1918. Last month eleven of the permits were for dwelling houses, valued at \$24,185, five were for factories or warehouses, valued at \$12,400, and 55 for repairs and alterations, valued at \$27,025.

President Hanna of the Canadian National Railways recently promised western delegations that a number of important extensions would be carried out this year: The road from Breux to Humboldt is to be completed; rails will be laid for 20 miles on the Vonda spur toward Melfort and the Priestville line will be extended ten or twelve miles. The board also has in mind the linking up of the Vonda spur with Melfort and thereafter with Saskatoon; and the running of a line from the coalfields west of Moose Mountains,

which would serve a large tract of settled country and, eventually give connection with the Hudson Bay Ry., which is being asked for.

An international committee has been appointed by representatives of interested civic organizations on both sides of the Niagara River, for the purpose of promoting the scheme for a peace memorial bridge between Canada and the United States. Immediate action is to be taken to secure funds. Private subscriptions will be solicited and, failing in this, the two governments will be asked to help. The Canadian representatives believe the Dominion will be ready to defray half the cost. The Automobile Associations of Ontario and New York will also be asked to aid. The plans call for a high level bridge connecting Massachusetts Ave., Buffalo, with Garrison roadway, Fort Erie. The cost is estimated at about \$2,500,000.

Work on the project to give the Canadian National Railways a route into St. John, N. B., via the St. John Valley Ry. is probably to be commenced in May. It is understood that arrangements are being completed whereby surveying parties will be immediately sent out, and it is expected that tenders may be called in April. The work includes reduction of grades and curves, general improvement of the roadbed, the strengthening of culverts and bridges and possibly the installation of some new ones. It is now also stated that the erection of a double-track bridge across the St. John River at Fredericton is planned. W. H. and M. J. Poupore Co., contractors, are making a proposition to the Canadian National Railways that, in order to expedite the preparation of plans so that the commencement of the work may not be delayed, the firm be engaged to make the surveys and prepare the plans for one half of the route between Fredericton and McGivney Junction.

Many municipalities throughout Western Canada are preparing their plans for the provision of memorials to the men who fell at the front. Community buildings, such as can be used by the public at large, seem to be generally favored. Brandon is figuring on an expenditure of \$250,000 on such a scheme, and Battleford, Sask., has decided on a \$75,000 building, and Yorkton, Prince Rupert, Edmonton and Jarow, are also considering similar propositions. In Calgary a soldiers' building erected by the citizens along with a swimming pool in the basement, a public hall and museum above, is suggested. Winnipeg citizens are favorable to the proposed Mall leading from the new Parliament Buildings. It is also stated that the grain growers in the three provinces are backing a plan to erect memorial halls in each district where they have a branch, the funds to be provided by the central organization and repaid by the locals in time.

Recent Incorporations

The Robertson Construction & Engineering Corporation, Ltd., head office, Niagara Falls, Ont., capital \$40,000.

Canadian Landscape Architects, Ltd., head office, Toronto, capital \$40,000.

The International Engineering Corporation, Ltd., head office, Toronto, capital \$750,000.

The Davis Slate & Manufacturing Co. of Canada, Ltd., head office, Toronto, capital \$5,000.

Ontario Sewer Pipe and Clay Products, Limited, head office, Toronto, capital \$300,000.

Morin, Simard, Limited, builders and contractors, head office, Montreal, capital \$50,000.

Montreal General Tool Co., Ltd., head office, Montreal, capital \$100,000.

Ontario Investments, Limited, head office, Toronto, capi-

tal \$40,000, authorized to carry on business of iron masters, steelmakers, steel converters, engineers and iron founders.

The H. K. Ferguson Company, a corporation created under the state laws of Ohio, has been licensed to carry on a general contracting construction, building and engineering equipment business in Ontario, with a capital of \$40,000. James Steller Lovell, of Toronto, has been appointed as the firm's attorney.

Personals

Wm. Forbes has been appointed county road superintendent for Oxford county, Ont.

Mr. W. S. Greenhill has been appointed chief engineer of the Vancouver General Hospital. He was formerly chief engineer of the Columbia Lumber Co.

Messrs. Wm. Fraser & Harold S. Kaplan, architects, have returned from Halifax, and have opened a new office in the Confederation Life Building, Toronto.

Messrs. Forsey P. Page & Stamford Warrington have returned from active service and have opened an office at 118 Victoria St., Toronto, where they will practise as architects.

Mr. Alex. J. Grant, formerly a canal engineer with the Department of Railways & Canals, now holds the position of Chief Engineer of the Welland Ship Canal, succeeding Mr. J. L. Weller, who resigned about a year ago when the work on the canal was closed down, due to war conditions.

Mr. Robt. A. McKenzie has resigned from the position of building inspector of the city of Vancouver, B.C., and goes to China to supervise undertakings for large construction concerns in that country. Mr. McKenzie served the city for eight years as assistant building inspector, and for three years in the position he is now leaving. His familiarity with construction work made him a very efficient and valuable head of his department.

Mr. James P. Gordon, late of the firm of Chipman & Power, consulting engineers, has been appointed town engineer of Trenton, Ont. Mr. Gordon is a graduate of the Faculty of Applied Science & Engineering, University of Toronto, in the year 1904; also an associate member of the E. I. C. During the present summer the town of Trenton will make considerable extensions to their waterworks, sewers, roadways and sidewalks and are fortunate in having a competent and experienced engineer in charge of the work.

Obituary

Mr. John A. Conley, a well-known contractor of St. Thomas, Ont., died suddenly as a result of heart trouble recently. Mr. Conley was born in Enniskillen, Ireland, 60 years ago.

Mr. Daniel Goldstein, a Toronto building contractor, met his death recently as a result of a fall from the third storey of a building. He was taken to the General Hospital after the accident but was found to have died on the way.

Mr. Charles Whitehead, a well-known pioneer railroad contractor of the Canadian West, died recently at his home in Brandon, Man. Mr. Whitehead was very well known in the western provinces, where he carried out considerable railroad construction work for the C.P.R. He was in his 83rd year.

Mr. W. I. Bishop, C.E., has been appointed managing director of the Ambursen Hydraulic Construction Co. of Canada, Ltd., and the Raymond Concrete Pile Co., Ltd., Montreal.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Charlottetown, P.E.I.

City Council plans construction of storm sewers on Kent, Rockford, Water, Pownal, Prince, Hillsboro and Grafton Sts. Clerk, W. W. Clarke.

Drummondville, Que.

Town Council plans repairing principal streets with Tarvia. Mayor, J. A. Montplaisir.

Hawkesbury, Ont.

Town Council plans sewer extensions. Clerk, Eugene Paquette.

Kelowna, B.C.

City Council plans paving roadway with macadam from here to McCulloch and Carmi. Clerk, G. H. Dunn.

Kentville, N.S.

By-law will be voted on March 27th, for construction of permanent streets costing \$50,000. Clerk, J. Carrol.

Longueuil, Que.

Tenders being received by sec.-treas., J. R. Bournet, until 5 p.m., April 7th, for concrete paving St. Antoine and St. Charles Sts. and Bord De L'Eau Road.

Nanaimo, B.C.

Plans are prepared for \$15,000 sewerage system. Clerk, Alex. L. Rattray.

South Woodlee, Ont.

Township Council has passed by-law for \$50,000 to aid in the construction of tile, stone and timber drains. Clerk, N. M. Mousseau.

Toronto, Ont.

Tenders are being received until March 28th, for water bound macadam, bituminous bound macadam and concrete roads and a number of bridges for York Highways Commrs. Engineer, E. A. James, 57 Adelaide E.

Board of Control plans improvements to corner of Bay and Queen Streets. Commr., R. C. Harris.

Railroads, Bridges and Wharves

Moose Jaw, Sask.

Tenders are being received by engineer, A. T. Fraser, Edmonton, until April 12th, for station for Canadian National Railways, Toronto. Architect, J. Schofield, Room 459, Union Station, Winnipeg.

Newcastle, Ont.

The Newcastle Harbor Co., previously reported in error, Newcastle, N.B., plans construction of \$15,000 wharf.

St. Thomas, Ont.

Plans, etc., are with the engineers, Jas. A. Bell & Son, Court House, who are receiving tenders until March 28th, for construction of two reinforced concrete highway bridges for County Council.

Tenders are being received by chief engineer, A. F. Stewart, until noon, March 29th, for construction of concrete abutments and one culvert between Sydenham and Ottawa, for Canadian National Railways, 27 Wellington St. E., Toronto.

Toronto, Ont.

T. & N. O. Ry., Imperial Oil Bldg., plans construction of three mile spur from Timmins to Metagami. Commr., J. L. Englehart.

Tenders are being received by chief engineer, A. F. Stewart, until noon, April 3rd, for construction of six concrete abutments and two culverts between Gormley and Mount Albert and two concrete abutments and three culverts between Oshawa and Cobourg, for Canadian National Railways.

CONTRACTS AWARDED

Galetta, Ont.

Work is to start on concrete arch bridge over Mississippi River for County Council: General contractors, Sawyer & Smith.

Ottawa, Ont.

Work is to start on two bridges for Municipal Council: Concrete arch bridge, Sawyer & Smith, Galetta; steel bridge, \$31,000, Ontario Bridge Co., Ltd., Crown Office Bldg., Toronto.

Paisley, Ont.

Rebuilding bridge for County Council: Cement work, \$3,124, Jas. A. McKinnon, care of F. B. James, Walkerton; steel work, \$4,600, Hunter Bridge Co., Kincardine.

Public Buildings, Churches and Schools

Campbellton, N.B.

F. Neil Brodie, 42 Princess Street, St. John, is preparing plans and will call tenders May 1st, for erection of \$25,000 two storey addition to school for School Board.

Chatham, Ont.

Plans are being prepared and tenders will be called shortly for erection of two storey addition to school for School Board. Architect, J. A. Methven, Fifth St., Victoria Block.

Drummondville, Que.

Town Council plans erection of \$30,000, two storey market hall. Sec.-treas., M. J. Marier.

East Angus, Que.

Parish Congregation plans erection of church. Curate, J. A. R. Plamondon.

Galt, Ont.

Plans will be prepared for Sunday school for Central Presbyterian Church.

Pastor, Rev. Mr. Davidson, 30 Lansdowne Ave. N.

Gravelbourg, Sask.

Plans are being prepared and tenders will be called soon for erection of \$100,000 college and \$50,000 hospital for owner in trust with architect, E. Fortin, 2161 Robinson St., Regina.

Guelph, Ont.

Ontario Agricultural College plans erection of four buildings costing \$300,000. Architect, F. R. Heakes, Parliament Bldgs., Toronto, will call tenders later.

Halifax, N.S.

City Council will call tenders shortly for erection of \$7,000 bathing house. Clerk, L. F. Monaghan.

Plans are being prepared for \$20,000 brick hall for New York Construction Co., 57 Duke St. Architect, A. E. Priest, Bedford Row.

Hamilton, Ont.

Plans are being prepared and tenders will be called shortly by architects, Stewart & Witton, 7 Hughson St. S., for addition to Gospel Tabernacle, Park St. N.

Hemmingford, Que.

Tenders will be received by architects, Gordon & Aird, 304 University Street, Montreal, until April 9th, for erection of 2½ storey brick school for School Commissioners.

Humberstone, Ont.

School Board plans erection of school. Sec.-treas., W. Kinsley.

Louth, Ont.

Bulk or separate tenders are being received by architect, A. E. Nicholson, 46 Queen Street, St. Catharines, until March 31st, for erection of two storey brick school for School Board, Sec. No. 3. Plans and specifications are with architect and at office of Contract Record, 345 Adelaide W., Toronto.

Mimico, Ont.

Tenders are being received by sec.-treas., John Kay, until March 29th, for erection of \$55,000 nine room brick addition to school for Town Council. Architect, Jos. Wooley.

Montreal, Que.

R. C. School Comsn., 87 St. Catherine St. W., plans erection of "St. Augustine" school. Sec.-treas., A. Lafontaine.

Newcastle, Ont.

Town Council, previously reported in error, Newcastle, N.B., plans erection of \$5,000 town hall.

Orillia, Ont.

Robt. Power, architect, 81 Brock St., Kingston, will prepare sketch plans for \$100,000 hospital for Town Council.

Peterboro, Ont.

The Peterboro Board of Education in-

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No Weighty Arguments Against Daylight Saving

IT is announced that the Dominion Government will not institute the Daylight Saving idea or, as someone aptly called it, Daylight "Finding," and it is safe to say that a very large percentage of the Canadian people will be keenly disappointed. The trial of a year ago was attended with practically no bad results, while on the other hand there were evidences everywhere of very real benefits. In the cities and towns where work is, even under the most favorable conditions, carried on under great pressure, the extra hour of God's fresh air and health-giving sunlight was a boon to every class of the community. It is true one occasionally heard a grumble that the plan deprived the working man of an hour's sleep, but there is no evidence and no reason why this should be the case. As one of those working men himself, the writer is able to affirm that there was no difficulty, after possibly the first week or ten days, in following out the regular winter routine of so many hours each for work, recreation and sleep. Nor has there ever been any

reason advanced why any one should be thus inconvenienced.

The one objection that really has weight is that advanced by the farmer. Anyone who knows farming conditions is well aware that it is not possible during certain seasons of the year to commence the work of the day before the sun has dried the dew off the ground or grain. This already means that unless he works on into the night he must necessarily get only a short day out of his employees. If the clock is put ahead another hour, he argues it will be another hour lost.

The fact is, however, that the farmer's hours in the summer are already practically independent of the clock. Of necessity, he does his work when the conditions are most favorable and employees recognize this fact. Whether the clock is put ahead or back one hour or ten hours can make no difference in these conditions. All that is necessary is that the law be so framed that it does not bind the farmer or his employee.

As against this single disadvantage, if it can be called such, there is the further offsetting advantage of a very considerable economy in the matter of light and heat. Statistics of last year in Canada and the statistics of many years in other countries, prove a distinct saving in both these items—real money in the hands of the workingmen, real economy of our resources. Is not this a thing worth working for?

What we would respectfully urge and what also we are confident would meet with the unanimous approval of the urban districts is that the clocks be advanced from May 1st to Oct. 1st. Last year one frequently heard it said that the date of changing back was too late. April 1st also seems a little too early. The middle course would, we believe, be the best solution of the problem.

Quebec Government Obtains Better Control Over Municipal Loans

THE Bill dealing with municipalities passed by the Quebec Legislature contains some drastic provisions concerning the expenditure of monies, raised by loan, for municipal improvements. The Hon. W. Mitchell, who introduced the Bill, pointed out that it sometimes happened that municipalities came to Quebec and asked ratification for loans, and when the Private Bill Committee began to raise a question as to the advisability of sanctioning such loans, the representatives of the municipalities would tell the committee that it would be better to sanction the loans as the works had already been executed. This, said Mr. Mitchell, is to be stopped. To this end a clause stipulates that no city or town corporation whatever may, by the law governing it, with the exception of the cities of Montreal and Quebec, give out a contract for construction or improvement works nor pass a contract to that effect, unless the by-law authorizing the contract or ordering the work has provided for the appropriation of the monies required for paying the cost of the same.

If the corporation has not in its funds, not otherwise appropriated, the amounts required for this purpose, the by-law must provide for the imposing of a special tax upon the whole municipality or upon the proprietors liable for the cost of such works, as the case may be, or for a loan. There is to be an exception, however. When a corporation is bound by law to obey an order of the Board of Health requiring

certain work to be done within a specified time, it may carry out such order and borrow the necessary money without observing the prescription of this article.

Contracts, outside those for which the exception is made, entered into contrary to these provisions, are to be void and shall not bind the corporation, and any ratepayer may obtain a writ of injunction against the corporation and the contractor to prevent the execution of the work. Members of councils which infringe these provisions are each to be liable to a fine up to \$500. In case of urgency the Lieutenant-Governor in-Council is authorized to allow a municipal council to derogate from the provisions of these restrictions.

Legislation Governing LaSalle Bridge Contracts

THE Quebec Legislature has passed the Bill concerning the LaSalle bridge, the contracts for the construction of which were terminated by the city of Montreal, the deposits made by the contractors being retained. The Bill was promoted by the contractors with a view to securing a settlement, it being contended that the failure to carry out the work was due to causes over which the contractors had no control. The city opposed the Bill, on the ground that the Legislature must not intervene in civic questions of pure administration, and especially on the question of the contract regarding the LaSalle bridge. The commission also insisted that any legislation on the question of the LaSalle bridge would serve as a precedent in several similar cases, in which the contractors have already made claims.

The Private Bills Committee amended the Bill in several particulars, but the Legislative Assembly struck out practically the whole of these, and restored a clause, struck out by the Legislative Council, for arbitration in case the Administrative Commission of Montreal do not agree to a settlement with the contractors. The Legislative Council thereupon gave way, and accepted the Bill as it came from the Assembly.

No Early Drop in Prices, Say Montreal Supply Men

THE question of a reduction in prices was discussed at a recent meeting of the Montreal building supplies firms. The subject was debated from various angles, the general opinion being that firms should reduce their prices to the lowest points with a view to stimulating building. It was pointed out, however, that the margins in some commodities were extremely small, and that the advanced freight rates were a hindrance to lower prices. Further, the supply houses were dependent upon the manufacturers for the raw material, and the question of reductions was one largely for the manufacturers. There was, it was also asserted, little chance of labor—which formed such a vital factor in the cost of construction—coming down, while the cost of living remained at its present level. Those who postponed building in the belief that the cost of the work would be materially lower in the near future were mistaken, in the opinion of the meeting, as there was no prospect of any such substantial reduction. "Build now" was therefore urged upon those who contemplated work of this character.

Toronto Seeks Legislation Permitting Operation of Disposal Plant

THE city of Toronto is seeking legislation in connection with the operation of the sewage disposal plant on Eastern Ave. The proposed bill reads as follows:

"Notwithstanding the provisions of the Municipal Act or any other act of the legislature or the decision or order of any court, the corporation of the city of Toronto may maintain and operate the sewage disposal works situated on Eastern avenue, together with all works, services and appurtenances necessary thereto, and no suit, action or proceeding shall be brought against the said corporation for damages or relief in respect of the maintenance and operation of the said works unless the corporation shall have failed to comply with any order, regulation or direction of the provincial board of health relative to maintenance and operation."

Scheme for an Eurasian Canal

Gustave Defosse, a French engineer, has worked out a scheme for a canal from the Mediterranean Sea to the Persian Gulf, involving a revival of the proposal of opening the middle Euphrates to navigation on a large scale. His plans, which are based on surveys made on the spot from 1901 to 1912, and which were prepared during the years 1913 to 1917, provide for a canal 69 miles in length, with a width of 328 ft. on the surface and of 230 ft. on the bottom, and a uniform depth of 32 ft. 9 in. The canal would start from the Mediterranean at Suedieh, following the course of the River Nahr-el-Asi to Lake Abiad, from which point a channel would be excavated to Khalat Balis, where it would join the Euphrates, and this latter stream, trained and improved, would provide the waterway to the Persian Gulf.

The scheme provides for a number of regulating dams of his own design, for which he claims the double advantage of not hindering navigation and of enabling constant levels to be maintained over great lengths. These dams, of which there would be one on the Suedieh-Khalet Balis section and four between Khalat Balis and the Persian Gulf, would consist of two massive piers having in their faces broad grooves between which slides the steel caisson that constitutes the moveable dam. As water is pumped into or out of it this caisson sinks till its upper part is flush with the bottom of the canal or rises so as to block the channel entirely, or occupies any intermediate position that may be desired to regulate the flow of water. At the points where regulating dams of this kind are placed the channel would be gradually narrowed to about a third of its normal width.

M. Defosse puts the cost of the canal and its appurtenant works at £64,000,000 (about \$320,000,000), and considers that it could be completed ready for traffic in seven years. The gross revenue from international traffic he estimates at a minimum of £5,860,000 (about \$29,300,000) on the basis of a daily entry of 50,000 tons from the Mediterranean, and of 30,000 tons from the Persian Gulf, and a charge of 5f. (4s. 2d., about \$1) a ton for the whole transit of the canal.

A Bill has been passed by the Quebec Legislature authorising that Quebec Streams Commission to spend an additional \$100,000—making a total of \$300,000—for the purpose of erecting storage dams on the Ste. Anne River.



An upstream view of the Bronte Creek bridge, one of four similar structures on the Toronto-Hamilton Highway

Four Concrete Overhead Arch Bridges on Toronto-Hamilton Highway

Design and Methods of Construction on Largest Structures of their Kind in Canada, Two of Which are Open to Traffic

IN the fall of 1917 the 40-mile concrete highway between Toronto and Hamilton was completed with the exception of four large bridges and approaches over the creeks at Mimico, Etobicoke, Port Credit and Bronte. The traffic on the highway at these points, pending the construction of the proposed new bridges, was carried on antiquated steel structures that were inadequate to the needs of the traffic and out of accord with the general character of the road. With their 16-foot roadways they were too narrow to accommodate the intensity of traffic existing on the highway and their old design and construction made them not only out of date, but dangerous under present loadings. The absence of sidewalks was a further detriment and added to the danger. Their use was maintained, however, until preparations were made for the erection of modern structures. The construction of the four new bridges was initiated last summer and two have been nearly completed and are already open for traffic. The work on the bridges over the Mimico Creek and Credit River was delayed until too late to make any formidable progress before winter set in and their completion will be delayed, consequently, until this spring. These new structures are located at the same sites as the old steel bridges which were removed. Temporary bridges were erected to carry the highway traffic during the construction work.

Under-deck Arches Out of the Question

The governing factor in the design of these bridges has been the low clearances, which make under-deck arches, unless shallow, out of the question. Consequently, concrete overhead arches have been chosen and the four bridges are similar in design, three of them, in fact, being absolutely identical in superstructure. Reinforced concrete is made use of throughout and the designs are based on the Hennebique system. The general features of design embrace a pair of parabolic overhead arch ribs, the thrust from which is taken up by a chord, or tie, which together with the bridge floor is suspended from the arches by hangers.

The floor slab is carried by a system of main and secondary beams, the former being cantilevered to take the two 6-foot side-walks. The parapets are constructed of reinforced concrete. The arch ribs have a rise of approximately 1 in 5 and are braced together by horizontal bracing members placed so as to give a minimum clearance over the roadway of 16 feet.

The following comparative table gives the general dimensions of the bridges:

	Mimico Bridge	Other Bridges
Span, c to c bearings . . .	100 ft. 4 in.	122 ft. 7½ in.
Width c to c of arch ribs . . .	28 ft. 4 in.	22 ft.
Height, c of tie to c of rib . . .	22 ft.	26 ft.
Overall width	44 ft. 8 in.	38 ft. 2 in.
Width of roadway	26 ft.	20 ft.
Sidewalks	6 ft.	6 ft.
Depth of arch rib	3 ft. 3 in.	3 ft. 3 in.
Hangers	12 in. x 15 in.	11 in. x 13 in.

Details of Design

The bridges have been designed to satisfy the specifications of the Ontario Department of Public Highways. The designed live load is 100 pounds per square foot of floor surface and concentrated load is considered as 20 tons on two axles at 10 foot centres and 6-foot gauge, with two-thirds the weight on the rear axle. The dead load on the Mimico bridge is considered as 9,900 pounds per lineal foot; on the other three bridges, 8,700 pounds.

The arch ribs are I-shaped, 3 feet 3 inches deep and 19 inches wide at the web, with the flange dimension decreasing towards the end of the bridge. The bracings, three on the Mimico bridge and four on the others, are 15 inches by 21 inches in section.

The thickness of the sidewalk slab is 4½ inches throughout with a slope towards the roadway of one-quarter inch to the foot. The thickness of the roadway slab proper is 7¼ inches, with an allowance of wearing surface from ¾ inches at the curb to 2 inches at the centre.

The concrete used in the arch rib, tie, hangers and

bracings, was 1:2:4 mix, with 1 inch stone, but the concrete in the connection between the arch rib and tie was 1:4 mix. The beams and slab constituting the sidewalk and bridge floor were of 1:1¾:3½ concrete with ¾ inch stone.

The drawings in this article illustrate the design of the steel work and show that the main reinforcing bars had to be bent accurately in order to facilitate the placing of them. As the steel is necessarily complicated in the connection between the tie and the arch

the east abutment at Mimico. At Etobicoke it was anticipated that the existing stone abutments of the steel bridge could be used, but it was found on opening up the site to extend these abutments that they had to be entirely rebuilt. At Port Credit and Bronte, rock was found at 30 to 40 feet below mean water level and rock-bearing piles were driven to carry the abutments at these locations.

The contracts for the bridges included the paving of the approaches with concrete in conformity with the highway. Hitherto these approaches were macadam.

The four bridges were constructed by three contractors and the following gives an idea of the different methods used by them on their respective pieces of work.

MIMICO CREEK BRIDGE

At the west side of the Mimico Creek bridge site rock was close to the ground surface and the excavation for the abutment was very light. It was carried out by hand and the cofferdam was only a few feet deep. On the east side, rock was deeper and the soil was excavated by a clamshell. Delay was caused on this job by the caving in of the cofferdam timbering and the consequent flooding of the pit. The abutments were concreted through chutes from a mixer on the bank.

Piles were driven in the river bed to carry the centering. When the piles were driven, a severe storm carried away some old crib work in the lake at the mouth of the river and swept it upstream lodging it between two of the bents without, however, causing damage.

At the close of the construction season the two abutments were completed and the deck form work in place. The steel is delivered and the forms are made, ready for completing the structure this season.

ETOBICOKE CREEK BRIDGE

In providing a temporary crossing over the Etobicoke creek pending the construction of the new



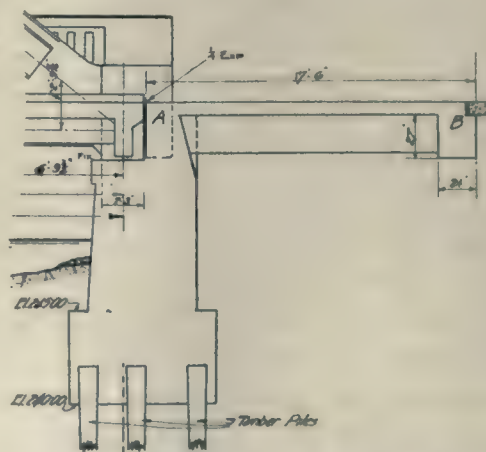
The Bronte Creek bridge from other angles

rib, special care had to be taken in the placing of concrete at that point to ensure an absolutely dense concrete.

Approach Sections a Feature

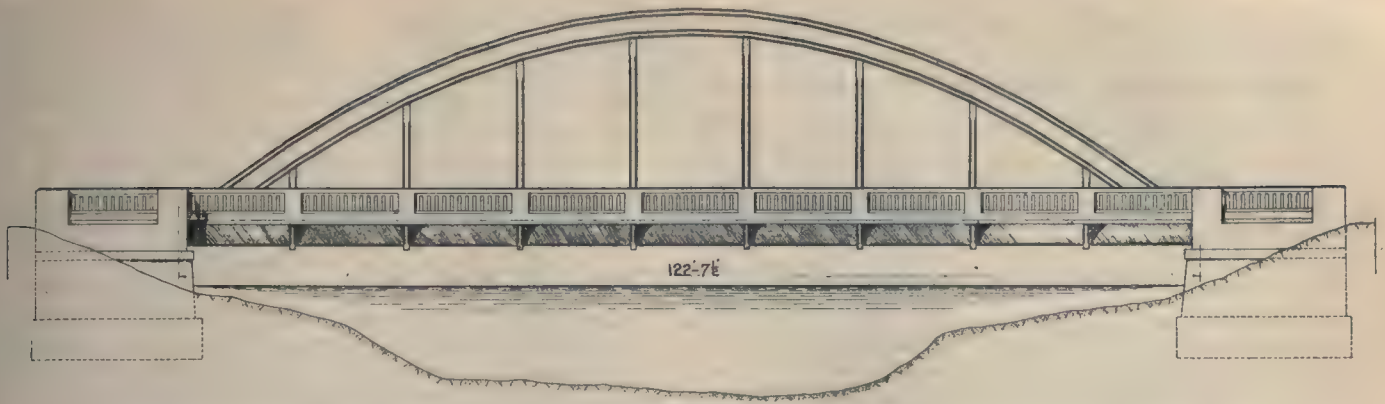
A feature of the bridges is the arrangement of special beam and slab approaches to the bridge to ensure a continuous even surface connection between the roadway and bridge floor without the bump usually encountered, which is due to settlement of the road adjacent to the rigid abutment. This approach consists of a slab spanning from the top of the abutment to solid soil where it meets the concrete road slab, thus bridging the backfill of the abutment excavation. The approach extension is carried on longitudinal beams and makes a smooth approach from road to the bridge deck without the danger of any possible settling of the abutment fill carrying the road with it. The soil under the approach slab is properly rammed with water and given every possible opportunity to become as solid as possible during the construction and gives considerable support to the approach slab. The slab will distribute concentrated loads over a large area.

The foundation conditions at the four sites varied somewhat. At Mimico and Etobicoke creeks rock was close to the surface—at the former location about 10 feet below mean water level in the creek and at the latter, at the bed of the river, which was only 2 to 3 feet deep. Consequently, at these points, abutments were founded directly on rock and difficult excavation, or unwatering problems, were not met with, except at



Special sections of beam and slab design from deck level at A to firm anchorage at B provide smooth approach to bridge

bridge at that point, the contractors did not feel justified in using the existing steel bridge, as permitted by the specifications, partly on account of the three or four days' disruption of traffic that would have developed but chiefly because of the expense of building new temporary piers and long approaches at the temporary site, to which the steel structure would have to be moved in its entirety. Consequently, the old



The Toronto-Hamilton Highway bridges are of this design. This compares with the through girder type of bridge in steel.

steel structure was dismantled and a provisional crossing afforded by a simple timber trestle, founded directly on the river bed which was rock. The 8 inch I-beams, resting loose on the truss chords, which comprised the deck of the steel bridge, were replaced on the 10 inch by 10 inch girths of the trestle and planked over with 3 inch planks to provide a 14 foot roadway.

Abutments on Rock

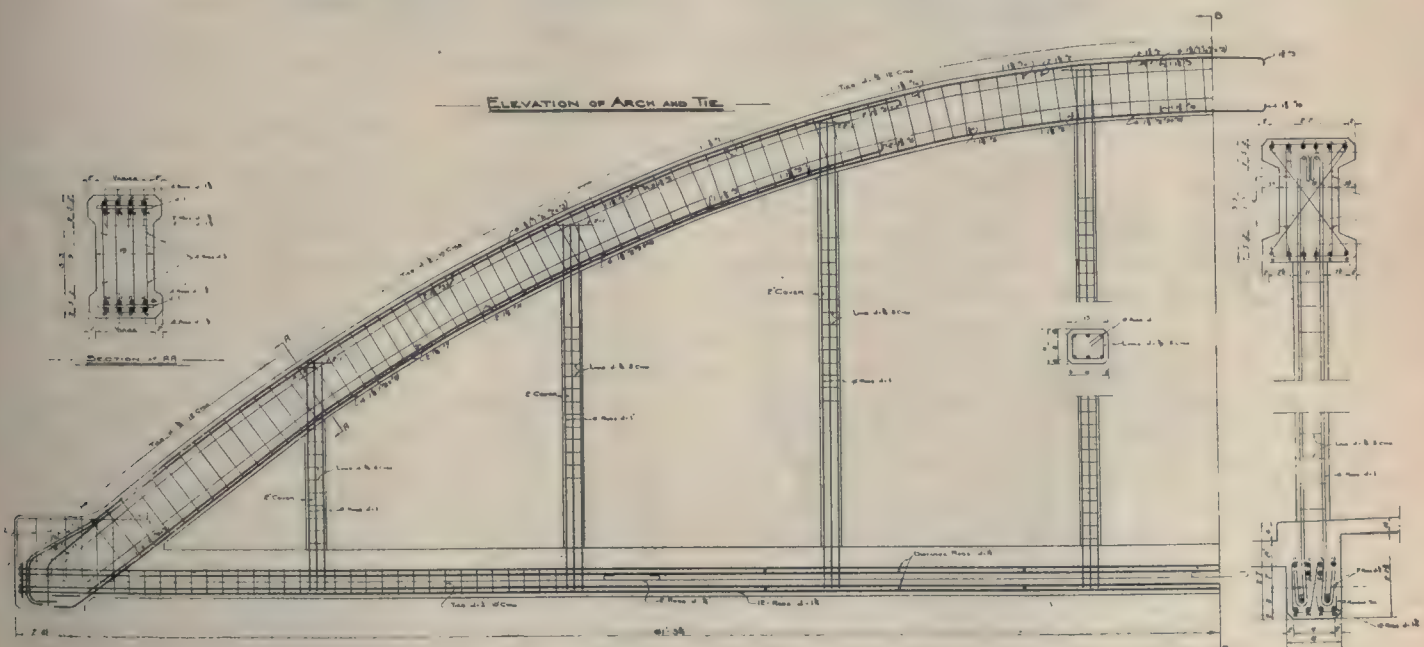
While the specifications applying to the Etobicoke bridge enjoined the use of the existing stone abutments as far as possible, an examination of these after the removal of the steel showed simply a stone facing with loose filling behind. They were, therefore, dismantled and new abutments constructed using the old stone backed up with concrete, thus making for all practical purposes a monolithic abutment. They were of the flaring wing-wall type and had a foundation directly on the rock which at this point was the bed of the river and close to the ground surface. No piling was thus necessary and, in excavating, a small timber cofferdam was built but no difficulty was encountered in keeping the site dry as the water was at this time—July—only two feet deep and, in fact, the river bed over the greater portion of its width was almost dry.

On the abutments special provision was made for the reception of the main chords of the bridge by

pouring solid blocks of concrete, the full thickness of the abutment. Expansion was provided for on one abutment by anchoring a $\frac{3}{4}$ inch steel plate on the abutment separated from a similar plate affixed to the springing by a sheet of brass to prevent rust and adhesion, with heavy grease lubrication to minimize friction and ease movement.

Erection of Forms

The centering for the arch ring was first laid out according to the plans in a field adjoining the bridge site. The forms were built in sections and numbered so that later they were easily erected in place without cutting or fitting. By laying out and building the forms very accurately on an adjoining site, no trouble developed when they were re-erected in place and time was saved by keeping the carpenters on this work while the abutments and floor were being poured rather than have them fit the centres only when they were required. After setting up the forms temporarily it was found that the instrument accurately checked the line and square measurements from which the carpenters worked. The bridge floor centres were carried on 4 x 4's resting simply on the bed of the river, a procedure that was considered satisfactory in view of the fact that it was not anticipated that the river would rise and endanger the shoring. In the



Arrangement of steel reinforcing in arch rib, tie and hangers

stream itself the posts were anchored in small rock-filled cribs.

Floor Poured Before Erection of Arch Rib Forms

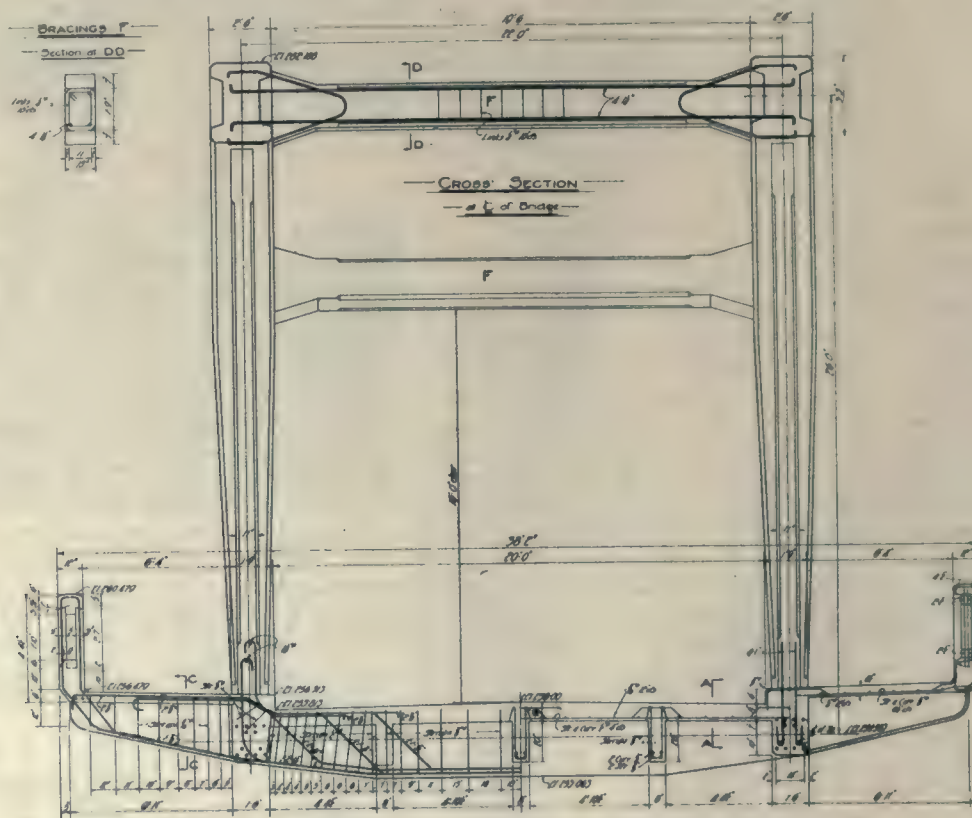
The scheme recommended in the first place for the erection of the centering was to build up all the forms and place the entire steel before pouring was commenced, but the contractors used an alternative plan in view of the fact that the shores of the arch ring, in that case, would have rested on the floor timbers and would have interfered with the placing of the concrete deck and the tie steel. Furthermore, to allow pouring, these timbers would have required boxing where they passed through the deck and the holes thereby produced would have needed filling after the removal of the centres. In view of these objections, the complete erection of the forms was not carried out by

from one rod to another. This method was changed and muff couplings or turnbuckles substituted to connect the lengths of rods together. Considerable additional labor was necessary in handling the long heavy rods and placing these turnbuckles.

Placing of Steel and Concrete

To facilitate the placing of the rib steel, the outer sheeting of each arch rib was left off leaving the arch completely open. The stirrups stipulated to be placed in each bay, were bunched between the hangers and the long rods passed through them. The placing of steel was somewhat complicated by the deep panels in the side of the arch rib. The hanger bars were wired up to enable the hooked lower ends to properly engage the tie steel.

In pouring, special care had to be taken with the



Cross-section of bridge to illustrate details of steel reinforcing in deck girders and bracings

the contractors but the floor system was poured and after setting, the shores for the arch-ring were placed on top of the concrete floor, with planks to distribute and equalize the loads. In each bay three double 6 x 6's, on hardwood wedges, took the load of the arch rib.

The placing of steel on this type of bridge is necessarily somewhat complicated as long heavy bars are required for the arch ribs and ties and a considerable number of stirrups are essential. The floor-steel and tie steel involved no special difficulties in their placing, as far as the Etobicoke bridge was concerned, as the absence of arch rib shores left the floor and tie timbers clear. The turnbuckles in the tie rods, however, were a little troublesome to place.

The reinforcement of the tie is made up of twelve 1¼-in. rods arranged in lengths so as to break joint. In the original design these rods were lapped and the ends were hooked, the concrete transmitting the stress

connection of the arch rib and tie, owing to the complication of the steel at that point. A suggested plan was to pour the floor and springing of the arch in one operation but the contractors decided to concrete the floor to within 8 or 10 feet of each end and then pour the remainder of floor and springing of the arch together, and thus avoid a joint in the concrete at this point.

For concreting, a plant, comprising mixer, cement sheds, tower and hoist, was established right on the river bed, as it was contemplated that the river would not rise before the completion of the pouring. The mixer was a gasoline operated, self-loader with hoist tower high enough to chute the top of the arch, erected in the middle of the span. The whole bridge was chuted. In concreting the arch ribs, the top sheeting was placed section at a time as the pouring progressed. The pouring of the hangers caused some trouble as they were difficult of access with the arch

formwork and steel in place. They were finally concreted from the side through an opening at the top. This trouble might have been averted if the hangers were concreted before the arch rib steel was placed.

For pouring the abutments the mixer was placed on top of the bank, and the concrete was chuted directly into place. The actual time of concreting was about six days.

Ice Jamb Carried Away Falsework

Shortly after the completion of the bridge in December, a considerable quantity of ice from upstream collected above the bridge site, although the water under the bridge ran clear. With the moderation of the weather a few days later the ice broke and jammed against the centering of the new bridge and the trestle acting as a temporary crossing. About 40 feet of the centering and trestle was carried away. The trestle was rebuilt but a second flood carried it away again. This time, however, the new bridge was sufficiently hardened to permit the stripping of the remaining form work and the placing of the bridge in operation, so that no interruption of traffic occurred. Notwithstanding that only twelve days elapsed after the completion of the pouring of concrete in the arch ribs, no signs of any over-stress whatever were observed in the completed structure.

CREDIT RIVER BRIDGE

The same general procedure as outlined above is being carried out in connection with the Port Credit bridge, although not much work has been done on it. The same contractors are doing the work and have dismantled the old steel bridge and provided a temporary roadway on a timber trestle resting on piles. The rock is not close to the surface at this point, as at Etobicoke. For this reason the falsework is to be carried on 64 piles driven by drop hammer and then cut off. The piles are arranged in bents of eight posts per bent, two at close centers for each arch ring. The loading per pile is from 9 to 10 tons. The centering used on the Etobicoke job will be transferred and reused on the Port Credit bridge as these bridges are identical in size. The same scheme for concreting will be used except that buggies will have to be used for the floor and a tower erected on the floor, owing to the impossibility of using the river bed.

If the winter had been normal, it is quite probable that the ice jamb on the Credit river would have carried out the temporary bridge and falsework piles, but the mild open weather has left the autumn's work undamaged.

In constructing the abutments which are founded on rock-bearing timber piles, the presence of numerous old cribs interfered with the sinking of the cofferdams. Some considerable trouble was experienced in making the west cofferdam sufficiently watertight.

Both abutments of this bridge have been completed and the piles are driven to carry the falsework of the new bridge.

BRONTE CREEK BRIDGE

At the Bronte creek site the contractors employed somewhat different tactics. The existing steel bridge was moved bodily onto crib abutments further upstream and twenty feet or so of timber approaches were added to the existing length. For the abutments 30 foot bearing piles were driven to hard surface—shale—about 20 feet below water level and cut off 5 feet below water level. A timber cofferdam was con-

structed around the location and kept unwatered while concrete was poured to the bridge seat level by a mixer on the bank discharging through chutes. The excavation was in good clay and the head of water in the river not great so that no water trouble developed and a small pump operating continually was sufficient to keep the site dry.

One-man stones, although permitted in the abutments, were used sparingly, the existing stone abutments being employed as displacers when such were used.

Falsework Carried on Piles

The falsework comprised ten bents of piles, 8 piles per bent. Their driving length was 30 feet and after being cut they were capped with 10 x 10's. The floor system was carried on 10 x 10 stringers. In this bridge the entire formwork was erected before any pouring was done at all and the carpenters did the fitting right on the spot. The arch rib was shored by 6 x 6 posts, cross and knee-braced, and it was curved to the designed parabolic arc, the base of the boxing being first constructed throughout the entire rib length. The sides were built in sections. The rib shores were boxed where they passed through the deck to facilitate removal after the concrete had set. The holes were filled up upon completion of the bridge.

In placing the steel some difficulty was encountered with the turnbuckles in the tie steel and in inserting the rib steel. To facilitate the latter operation the siding was left off at intervals, also the stirrups were placed in position and the rods passed through them.

Concrete Plant

For concreting, two mixers were used, one at each end, and the floor was poured by buggies. The same procedure as in the Etobicoke job was followed, that is, the floor was concreted to within eight feet or ten feet of the ends and the remainder of the floor, springing and rib, were poured in a further operation. Upon completion of the floor a tower was erected in the centre and the concrete hoisted up in barrows and dumped into chutes from the top. Men on the rib puddled the concrete as it was poured. The suspension members introduced difficulties. In the case of these, one side of the form had been left open and built up four feet at a time, men pouring the concrete by hand from buckets. As the pouring approached the top, a trestle was erected beside the hanger and the concrete hauled up by block and tackle.

Considerable difficulty was experienced on this job by the fact that it was the farthest from Toronto and the other three bridges being closer had the pick of the available labor. The absence of local electric transportation further aggravated the troubles of the contractors so that a small camp had to be established.

Steel Detailing

On these bridges the placing of the steel was greatly facilitated by the manner in which the details for the bending of the rods were prepared. Dependable and accurate shop fabrication was essential to minimize any difficulty in the placing of the bars in position and such shop work was ensured by the system of detailing developed by the engineers. The complete bending data were listed on "detail and employment sheets," a typical section of which is shown herewith. The use of these sheets, with the information contained on them, makes reference by the steel fabri-

cator to drawings unnecessary and also permits accurate checking.

The "detail and employment sheets" are used in conjunction with "standard bending sheets" in which standard types of bent rods are illustrated and numbered for reference. As the types embraced in the standard bending sheets are of general application without reference to specific pieces of work, the dimensions are indicated in a general fashion by letters, a, b, c—etc. If in the "detail and employment sheets" any items are bent to a standard shape, the type number is referred to, followed by the specific values of the lettered dimensions. Thus, in the sheet illustrated, item 57 comprising two 5-8 in. bars, is bent to the design of type 8, with a, b, and c having lengths of 8 ft, 5 in., 6 in., and 9 in., respectively. Also item 59 is of

co bridge, Toms Contracting Co.; Etobicoke and Port Credit bridges, Frid Construction Co., Charles Taylor, superintendent; Bronte bridge, Lewis Construction Co.

Ottawa Engineering Alumni Active

FOLLOWING a period of inactivity due to the war, the Ottawa Branch of the Engineering Alumni Association of Toronto held a reorganization meeting in the University Club. The President, Mr. T. Shanks, presided, and a number of addresses were delivered, among the speakers being Mr. H. G. Acres, of the Hydro-electric Power Commission of Ontario, and Mr. F. S. Rutherford, of the Soldiers' Civil Re-establishment Commission. The following officers were elected for the

DETAILS AND EMPLOYMENT OF STEEL BARS					Sheet No. 3
ITEM NO.	DESCRIPTION	DIAMETER OR SECTION	NO. OF BARS	LENGTH	DETAILS OF BENDING
No. 16 Cantilevers C-1. (To make one) con'td					
47	Stirrups	5/16"	2	6'10"	a=2'6" b=9"
48	"	"	1	6'6"	a=2'4" "
49	"	"	1	6'4"	a=2'3" "
50	"	"	1	6'2"	a=2'2" "
51	"	"	1	5'10"	a=2'0" "
52	"	"	1	5'0"	a=1'10" b=6"
53	"	"	1	4'8"	a=1'8" "
54	"	"	2x1	2'3"	Type 22. a=12" b=7/8" c=1"
55	Ties	3/16"	4	2'2"	Type 20. a=9" b=7/8" c=3"
No. 4 Cantilevers C-1. (To make one)					
56	"	5/8"	2	12'3"	
57	"	"	2	9'8"	Type 8. a=8'5" b=6" c=9"
58	"	"	2	7'3"	" a=6'3" b=3" c=9"
59	Stirrups	1/2"	8	14'9"	Type 33. a=3'2" b=5" c=6" d=2 1/2" e=4"
60	Sus. "	1/4"	2x5	2'6"	Type 23. a=12" b=5" c=1/4"

Steel bending details are tabulated in this manner so that reference to drawings is unnecessary

type 33, with a, b, c, d and e of 3 ft. 2 in., 5 in., 6 in., 2 1/2 in. and 4 in., respectively. The majority of the steel conforms, of course, to standard bending shapes, so that a simple cross reference to the standard bending sheet will give the details required for fabrication. Should any of the steel not conform to a listed standard shape, a sketch is appended in the "detail and employment sheet" with the dimensions marked thereon. Examples of this are afforded by items 47 to 53 and item 56.

Each item in turn is thus listed and detailed, so that no reference need be made to drawings. They are collected under the headings of the units to which they belong, these units each being lettered on the plans for reference.

After the bending details have been listed, the information about the steel is collected and transferred to "order sheets," where the lengths and weight of steel of each diameter are itemized and totalled for ordering.

The bridges were built for, and under the supervision of, the Toronto and Hamilton Highway Commission, the chief engineer of which is Mr. S. A. Cummingford. They were designed by F. G. Engholm & Partners, Ltd., Toronto. The contractors were: Mimi-

ensuing year: A. F. Macallum, city commissioner; secretary-treasurer, G. H. Ferguson, of the Conservation Commission; executive committee, J. L. Rennie, J. B. Challies, A. T. C. Challies, William Bryce, R. W. Morley, G. C. Cooper.

Regular meetings of the branch will be held from now on, and it is hoped to make the organization an active and prominent one in the city of Ottawa.

Will Discuss Industrial Relations

The Association of Montreal Building and Construction Industries is arranging for a special meeting to discuss the subject of advisory councils for employers and employees in the building trade. The directors feel that this is a subject of vital interest to all members of the association, particularly in relation to the maintenance of good relations between firms and their employees.

A Bill introduced into the Quebec Legislature provides that all plans for filter and sewage systems must be submitted to the Superior Board of Health for approval before being laid before the ratepayer in the form of a by-law. These plans have to be prepared for the municipalities by a graduate engineer.

Gravity Water Supply from Mountain Source for City of Trail, B. C.

Waters of Lake 1850 ft. Above Town are Diverted to Form Adequate Supply—Sewage Discharged into Columbia River

By A. L. McCulloch, M.E.I.C.*

ON account of the rapid increase in population on Trail, B. C., from 2,000 when the war started to 4,000 in 1916, due to extensive developments of the plant of the Consolidated Mining and Smelting Co., particularly zinc and copper refineries, the existing waterworks system was insufficient for domestic supply and totally inadequate for fire protection. It was therefore necessary to practically reconstruct the system and find an adequate supply of water not only for present, but for future requirements.

The old system was constructed by a private company, and extensions were made with a view to present dividends instead of future requirements. The system was taken over by the municipality about 1910, and some extensions were made. The old system was a gravity supply from Gorge Creek, latterly supplemented by additional water from the Smelter gravity supply.

Gravity Scheme Utilized

Owing to the smelter company utilizing the whole low water flow of Trail, Stony Rock and Murphy Creeks, there were only two sources of supply available: (1) Gravity supply from Cambridge Creek, supplemented by water diverted from Violin Lake. (2) Pumping from Columbia River.

The gravity supply from Cambridge Creek was the system adopted. Cambridge Creek is a small stream with a drainage area of about five square miles and a low water flow of about 500,000 gallons per day, with its source in the mountains around Violin Lake. At one time it probably ran into Violin Lake. Violin Lake is at an elevation of 1,850 feet above Trail and seven miles distant. It is a long narrow lake about a mile long and 800 feet wide at its widest part, with a depth of 60 feet and a surface area of 50 acres. It has a drainage area of not exceeding 1.5 square miles with a yearly precipitation of 30 inches and a seasonal snow fall of 128 inches. The low water flow is 250,000 gallons. Violin Lake is the head waters of Nigger Bar Creek which flows south into the State of Washington. The valley at the outlet end of the lake is very narrow, and by constructing an inexpensive dam the whole run-off from the lake can be stored and used as required.

Diversion of Flow

The obstacle to the diversion of the water from Violin Lake into Cambridge Creek is a divide or ridge 23 feet above the level of the lake and 2,650 feet long. Soundings taken indicated the existence of rock at a depth of 16½ feet, so that it was decided to raise the level of the lake permanently 7½ feet and lay a 14 inch glazed tile pipe conduit 2,200 feet long to Cambridge Creek through the divide at a depth of 16½ feet on the ridge, with suitable control gates to control the flow. The point of diversion of the conduit pipe line is about three miles distant from the business por-

tion of the town and about 680 feet higher in elevation. This conduit pipe line has been constructed, but it was late in the fall when tenders were asked for the dam and as no bids were received, the dam at the outlet has yet to be built. This dam will be of earth with a concrete core cut-off wall and overflow; it will be 16 feet high with a crest length of 165 feet. At a later date when all the water from Violin Lake is required the dam will be raised to a sufficient height to prevent any overflow, into Nigger Bar Creek.

It is estimated that the lake has a storage capacity of 100,000,000 gallons between the 7½ and 12½ foot contours, and 275,000,000 gallons between the 7½ and 20 foot contours. Violin Lake is estimated to be capable of supplying 350,000,000 gallons per year, which can be further increased by diverting the head waters of Cambridge Creek into the lake. The whole drainage area of the lake is steep rocky mountain side coming down to the water's edge.

Distribution

There is a drop of 1,200 feet from Violin Lake to the diversion weir on Cambridge Creek. The conduit pipe line from Cambridge Creek is an 8 inch lap-welded steel pipe 8,500 feet long with a drop of 306 feet, and a free discharge at the lower end. It has a capacity of 1,900,000 U. S. gallons per day. The lower end discharges into a concrete sump well from which it passes over a measuring weir into a screen chamber, and thence to the distribution system for distribution at will. The distribution reservoir at the city limits has a capacity of 1,000,000 U. S. gallons. It is partly in excavation and partly in an embankment. It has a depth of 10 feet of water. It is lined with 18 inches of a clay mixture, with 25 per cent clay put in layers of 6 inches and thoroughly rolled, and on top of this 6 inches of concrete with expansion joints, using slabs about 22 by 28 feet.

The material excavated being principally boulders and gravel, a great deal of the material in the embankment came from outside the work. The reservoir has an elevation of 374 feet above the business or lower portion of the town, which gave too great a pressure, and pressure reducing valves were used on the two supply mains so as to control the pressure on the low level part of the town to 110 lbs. From the reservoir there is a 12 inch steel main 1,500 feet in length from which point it branches and a 6-in. high level and an 8 inch low level pipe are run to the centre of the town. All the extensions were made with steel pipe, and all the wood pipe in the old system was replaced with steel.

In the extension to the system there has been installed as follows: 1,500 lineal ft. 12 inch steel pipe; 15,170 lineal ft. 8 inch steel pipe; 9,100 lineal ft. 6 inch steel pipe; 1,520 lineal ft. 4 inch steel pipe; 33 fire hydrants; 24 gate valves; 2 pressure reducing valves.

The total cost of the water works extension with

*Consulting Engineer, Nelson, B.C.

the Violin Lake storage reservoir completed will be about \$90,000.00.

Disposal of Sewage is Simple

As Trail is a hillside town situated on the bank of the Columbia River the question of sewage disposal was very simple. The Columbia River at this point is very rapid and has a low water flow of 14,000 c.f.s., and the provincial health authorities permitted the sewage to be discharged into the river without treatment. The outlet pipe is submerged below extreme low water and in swift water, so that it is never seen.

The system adopted was influenced by the fact that the town was built on the bank of the Columbia River and has two creeks running through the town into which the surface water discharges, causing very little trouble. The system is constructed to take roof water and surface water from a limited area of the town.

The main sewers are 15 inch with a fall of four-tenths of one per cent and 12 inch with a fall of 1.4 per cent. All lateral sewers are 8 inch, the grades on which vary from four-tenths of one per cent all the way up to 43 per cent. There is one section of 120 feet with that grade and another section, 650 feet long, with a grade of 22.6 per cent.

Cost of System

The total length of sewers constructed is 24,150 lineal feet, costing \$49,160 including interest on temporary loan during construction, engineering and inspection, or an average cost of \$2.036 per lin. ft. The sewers were constructed on the local improvement plan on the initiative of the city council, all the work being done as one local improvement work, the average cost per foot of the whole length of sewers

constructed being the assessed cost against the property benefited, the city paying for street and lane intersections, part of flankage and exempted property. The assessable cost of the sewers including the construction costs, the interest on temporary loan, and the loss on sale of the debentures amounted to \$54,000.00 or a cost per lineal foot of sewer of \$2.24 or \$1.12 per lineal foot of property frontage, making a yearly assessment of 12 cents per foot frontage per year in 20 annual assessments.

Materials Obtained at Pre-War Prices

All these works were constructed during 1917 and 1918 with high prices prevailing for material, and factory delivery a matter of time, it will probably be of interest to know how Trail fared in securing the necessary material. Immediate construction was necessary for the water works system and it was thought that to avoid long delay in commencing construction, it might possibly be necessary to use wood pipe for the conduit pipe line and the high level distribution main, but an arrangement was made to secure from the city of Vancouver from their surplus stock, the steel pipe necessary to complete the whole system. The steel pipe, hydrants and valves were all purchased from the stock at Vancouver for immediate delivery at prices very much below current factory prices.

As Trail was in the competitive territory of three glazed tile pipe manufacturing centres, viz., Medicine Hat, Victoria and Spokane, the sewer pipe was purchased for immediate delivery from Victoria and Medicine Hat at a price not exceeding pre-war costs at Vancouver.

The plans for the new waterworks and sewerage system were prepared and the construction supervised by the author.

Recommendations for Inexpensive Houses

Ontario Housing Committee Makes Suggestions for Cheap But Acceptable Houses and Offers Schemes for Economizing Construction

WITH the appropriation by the Ontario Government in July, 1918, of two million dollars for housing and that of \$25,000,000 by the Federal Government in the following December, interest in housing development has been greatly stimulated. Throughout many of the towns and cities local commissions have been studying the situation and offering recommendations for the promotion of schemes to suit their various requirements. A provincial organization, the Ontario Housing Committee, in investigating the same problems have made a preliminary report embodying recommendations as to acceptable standards of inexpensive houses, such as might be built with government assistance, and have, in addition, presented more or less complete working drawings and specifications illustrating and describing various types of construction.

In this committee's report, before the specific designs are considered, a general resume of the requirements is presented, and certain standards of design are determined upon, based on a consideration of the essential and desirable features of inexpensive houses.

The essential features are summarized as follows:

1. Sufficient land to give each family privacy and

plenty of air; 2. Water tight floors, walls and roof; 3. One, or more, rooms for cooking, eating and general day use; 4. Bedroom for parents' use; 5. Bedroom for male children; 6. Bedroom for female children; 7. Provision for toilet with sanitary water closet and sewer connection; 8. Running water supply fit for drinking; 9. Kitchen sink with waste connection to sewer.; 10. Uninterrupted daylight and ventilation through windows in every room.

Additional features which are so desirable as to be almost essential are:

1. Bath tub and lavatory, with hot and cold water supply; 2. Laundry tub with hot and cold water supply; 3. Direct sunlight in all principal rooms; 4. A second room, in addition to that used for cooking; 5. Clothes closets; 6. Porches and verandahs.

Further additions of desirable features would include:

1. Electric light; 2. A separate dining-room; 3. A cellar; 4. Furnace for heating.

No Attention to Number and Use of Rooms

In the commercially built dwelling of the past, the mistake has been made of providing too many, and frequently too small rooms. Sufficient attention has

not been paid to the use of rooms provided and their place in relation to one another. A man's dwelling is governed by his earning capacity, just as his clothes, food, or any other commodity; but there is a limit beyond which we cannot go and maintain decent living standards.

Recognition of these facts and a careful study of the actual requirements suggest that houses ranging from four to six rooms are best suited to the needs of the average workman. Of these the five-roomed type, containing three bedrooms, should predominate. The four-roomed type, providing only two bedrooms, is suited only to a workman without family, or to one with a small family. If more than six rooms are provided the tendency is to make up the additional expense by sub-letting to roomers, usually with injurious effect to home life.

This list of essentials and desirable features, together with the considerations enumerated have determined standards, representing the minimum requirements for safety, health, comfort and convenience in industrial houses.

Grouping

It is recommended that a space of at least twelve feet be preserved between houses or groups of houses in all new developments; also in the case of houses with side windows, other than those from stairs, halls or pantries. However, where the size of lots is fixed, or where existing buildings interfere, a narrower space may be unavoidable, but such passage should be at least four feet wide, without windows other than those from stairs, halls or pantries. Houses of frame construction, in whole or in part, should have a space of at least fifteen feet between them.

Duplex houses or cottage flats are recommended only as a substitute for tenements. They should not be more than two storeys in height, and not more than three rooms in depth, except the end house of a duplex group, which may be four rooms in depth.

Open Spaces

The rear of the house should be at least fifty feet from the rear of the lot. In new developments the front wall of the house, projecting steps or verandah should not be nearer than twenty feet to the street pavement or roadway.

Space for gardens is desirable, also play space for children. Local conditions will determine whether there should be individual or community allotments and playgrounds. Access to the rear should be provided; in the case of group houses service lanes are desirable. These should be paved, drained, lighted, and not less than twelve feet in width. Four-foot passage ways between buildings should be paved. Out-buildings are not desirable. Open fences or hedges are recommended. Close board fences are not acceptable.

Size of Houses

Minimum number of rooms, four, exclusive of bathroom and kitchenette. No house should be more than two rooms deep unless it has at least twelve feet of clear space between it and the next building, in which case detached, semi-detached and group houses may be three rooms deep, and duplex houses may have a depth of four rooms. The types of houses recommended are:

Four-roomed type: Living room, kitchen, 2 bed-

rooms and bathroom, or living room, dining room-kitchenette, 2 bedrooms and bathroom.

Five-room type: Living room, dining room-kitchenette, or kitchen, and 3 bedrooms and bathroom.

Six-room type: Living room, dining room, kitchen, 3 bedrooms and bathroom.

The minimum size of rooms is given in the following table:

Living Room	144	sq. ft.	narrowest dimension	11 ft.
Dining Room	120	"	"	10 "
Kitchen	80	"	"	8 "
Kitchenette	50	"	"	6 "
Bedroom No. 1	120	"	"	9 "
Bedroom No. 2	100	"	"	8 "
Bedroom No. 3	75	"	"	7 "
Bathroom	35	"	"	5 "

Ceiling

Minimum height of ceiling, 8 feet. Sloping ceiling will be acceptable only under the following conditions: Roof space above that portion of ceiling to be of ample size, preferably ventilated; space between rafters of sloping portion to be adequately ventilated into roof space; bedroom to have greater window area and better ventilation than the minimum permissible for a standard flat-ceiling room; bedrooms to have a minimum height of 8 feet over an area of at least 40 square feet, with a minimum flat ceiling width of $3\frac{1}{2}$ feet, and a clear height of not less than 6 feet over an area of at least 75 square feet with a minimum width of 7 feet.

Cellars

No living quarters to be in basement or cellar except where the land has a decided slope. Cellar to have a clear height of 6 feet 6 inches and to be lighted by at least one window opening directly to the outer air and to be provided with another opening located so as to provide cross ventilation.

The walls and floors to be damp-proofed or waterproofed, as conditions may require. Where conditions require waterproofing, weeping tiles to be placed around the footings and graded to follow the natural flow of the ground water.

Where the cellar is omitted, foundations may consist of either continuous masonry wall, or masonry piers two feet from finished grade to first floor. The space under the house to be drained, enclosed and ventilated.

Light and Ventilation

Every room to have at least one window opening directly to the outer air. One window is sufficient in small bedrooms, but more than one is desirable in other rooms. Each room to have a window area of not less than 12 square feet. Minimum window area to be measured between stop beads. Window head to be as near ceiling as practicable. Cross ventilation, as direct as possible, to be provided for all rooms through windows, transoms, or doors. Every bathroom to have a window of not less than 6 square feet in area opening directly to the outer air.

Materials

Brick, hollow tile, stone or concrete preferable. Wooden frame with exterior walls of stucco, shingles or clapboard acceptable for detached or semi-detached houses. Wooden frame with exterior walls of stucco acceptable for group houses. Outer walls to be insulated against dampness and condensation. Rat nogging to be provided. Division walls to be of brick, hollow tile or concrete.

In planning inexpensive houses consideration must

be given to economy and the report goes into considerable detail in determining methods in which economy may be practised. If a single house is considered, the nearer it approaches a square the greater the economy. As the plan changes from square to oblong, the ratio of wall area to floor space increases, and with it, the cost. Any departure from the right angles means increased labor and waste of materials in cutting. Furthermore, in determining the general lines of the building, standard sizes and lengths of available materials should be considered. Floor joists are obtainable in lengths of 10 ft., 14 ft., etc. Why not then consider these units in planning? A room planned for a clear inside dimension of 11 ft. 0 in. can be spanned by a 12 ft. 0 in. joist, without an inch of waste. Increase the dimensions to 12 ft. 0 in. and a 14 ft. 0 in. joist is required, incurring a waste of 1 ft. 0 in. Multiply the waste by the number of joists required in the building, continue the waste throughout a thousand buildings, and the total amount wasted will go far toward building several houses.

The same economy can be studied in the placing and design of door and window openings. There are many instances where from the standpoint of architectural design, the effect would be equally satisfactory if the spacing of openings corresponded with building material units. The waste pile found about every building, especially small houses, bears witness to the lack of consideration these items receive. As material prices increase, the necessity for such conservative methods becomes more and more apparent.

Window sizes based on stock glass units is another economy. The speculative builder has for years determined window openings by standard sizes of glass. Architects take exception to the proportion of such openings, but it is possible to design windows of good proportion in perfect scale with the work generally, and adhere to standard glass sizes.

These observations are not intended as a defence of speculative builders' methods. It is, however, a plea for a careful study of building methods, or materials available, and the application of the results of such study to future building, to the end that people of low earning capacity may obtain permanent homes and pleasant and healthful surroundings.

Underlying Principles not Understood

The materials available in various localities have developed certain standard methods of construction, but of recent years there has appeared a lack of appreciation, or understanding of underlying principles, which is mainly responsible for the rapid depreciation of present day work. Builders perfectly understand that shrinkage, in wood construction especially, is the cause of much settling, resulting in damage to plaster, sagging of doors and windows, and general depreciation. It is also generally recognized that much of this can be overcome by avoiding placing wood in compression across the grain. Yet it is a fact that except where buildings are erected under careful supervision, because erection is somewhat simplified, this consideration is sometimes overlooked, and studs, plates, sills, or joists are framed so as to multiply instead of to reduce the shrinkage.

The brick wall is probably the standard by which other wall construction is judged. The appearance of brick houses is greatly improved where care is taken to avoid a glaring colour in the brick. Of recent years many other materials have come into more general use. Hollow tile will be found a perfectly satis-

factory and economical material for inexpensive houses, provided care is exercised to see that only well burnt hard tile is used, and that all joints are filled with mortar. If this is done, and a Portland cement stucco applied to the exterior, the furring may be omitted on the interior and the plaster applied directly to the walls. Hollow tile for load bearing walls should not be less than 8 inches thick.

A hollow tile is also manufactured having a salt-glazed exterior which proposes to eliminate stucco. This has proven very unsatisfactory on at least one large housing development in Canada, and until the product has become more widely known, it is not recommended for housing work generally.

Concrete For Small Houses

Concrete has been advocated as ideal for house construction. There are two classifications for concrete construction: Monolithic, i.e., poured into place, and Precast. The monolithic concrete wall is cast between forms of wood or steel, and providing the mixture is of proper density, gives a permanent and jointless waterproof wall. The wall has, of course, to be furred, lathed and plastered in the same manner as brick, to eliminate condensation on days when humidity is high. Unfortunately, the surface of concrete, as it comes from the forms, has very little texture, and is generally unsatisfactory in colour. The usual practice, therefore, has been to apply a coat of stucco for the purpose of overcoming this unsightliness. This, however, means added expense.

The cost of forms for monolithic construction also constitutes a very heavy charge against the work unless they can be re-used many times. There are several types of sectional forms on the market, but none of them are sufficiently elastic to permit of variety in exterior treatment and, consequently, most of the concrete house developments are monotonous and uninteresting.

Precast concrete construction consists of sections cast in a yard or in a plant, and then set in position. The size of the precast units varies from concrete blocks weighing about 65 pounds to an entire wall or floor section. The construction is undoubtedly permanent, but in appearance is not very satisfactory. The expensive mechanical equipment required for setting large units also restricts its use to large developments.

Small precast units, known as Hydro-Stone blocks are being used extensively on reconstruction work in Halifax. These blocks are entirely different from other concrete blocks, both in shape and in finish. Consequently, practically all the objections which heretofore have been raised against the use of concrete products are overcome. A somewhat extensive plant, however, is required for the economical manufacture of the blocks, and unless the work is undertaken on a large scale, these units cannot profitably be employed.

Stucco as a finish for exterior walls is rapidly gaining in favour, and is desirable both on account of the elimination of frequent repainting, as well as its fire resisting qualities.

Frame Designs

Where frame construction is permitted, the cheapest wall is a 2 inch by 4 inch stud frame, lathed and plastered on the inside, sheathed with Bishopric stucco board on the exterior and finished with cement stucco. Better results will be obtained if the exterior walls are covered with sheathing board before apply-

ing the Bishopric stucco board. A still further improvement, considered from the standpoint of heating, will be to use Bishopric stucco board and plaster on the inside of exterior walls instead of lath and plaster.

Wood shingles or clapboards give satisfactory results, although creating a greater external fire hazard. There is always, however, a maintenance cost for repainting. This can be greatly reduced by the use of stain. As a matter of fact it is extremely doubtful whether any paint should be used on the exterior of inexpensive houses. A lead and oil paint, satisfactory in appearance, and with good wearing qualities, cannot be obtained in the cheaper grades, and there is nothing more unsightly than a house upon which cheap paint has been used. There are, however, a number of very satisfactory creosote stains on the market and these are recommended for the general exterior use.

Relative Costs

The cost of different building materials varies greatly with the locality, and consequently, an estimate which would hold in Toronto would be of little value to the builder in some other section of the province. It is believed, however, that relative values would be of assistance, and the following table giving such relative cost has been compiled, the first column giving the cost per square foot of wall surface and the second column the relative cost of a six family group using the cheapest construction as 100 per cent:

	Cost per sq. ft. of wall surface.	Relative cost for six- family group.
Balloon Frame.. 2" x 4" studs	18c	100%
Exterior—Bishopric Stucco Board and Stucco		
Interior		
Interior—Lath and plastered		
Balloon Frame.. 2" x 4" studs	23c	101.7
Exterior—Bishopric Wall Board Shingles...		
Interior—Lath and Plaster		
Balloon Frame.. 2" x 4" studs	26c	102.3
Exterior—Sheathed Bishopric Stucco Board		
and Stucco		
Interior—Lath and Plaster		
Balloon Frame.. 2" x 4" studs	26c	102.3
Exterior—Sheathing, Building Paper and		
Shingles, stained		
Interior—Lath and Plastered		
Balloon Frame.. 2" x 4" studs	27c	103.1
Exterior—Sheathing, Building Paper, Clap-		
boards, painted		
Interior—Lath and Plastered		
Balloon Frame.. 2" x 4" studs	31c	104.5
Exterior—Sheathing, Building Paper, Furring,		
Metal Lath and Stucco		
Interior—Lath and Plastered		
8" Brick Wall—Furred on inside	40c	107.6
Lath and plastered		
8" Hollow Tile—Exterior stuccoed	40c	107.7
Interior plastered		
8" Concrete Wall—Exterior stuccoed	47c	110.7
Interior lath and plastered		

Steam Heating Plant for Sand and Gravel

PERFORATED steam pipes in sand and gravel bins, steam coils in the water supply barrel, and a concrete heater enabled the American Concrete Steel Co. to pour concrete during the recent unusually cold snap when the mercury dropped to 13 degrees below zero. This remarkable cold weather concreting, described in "Contracting," was accomplished on a new three-story, reinforced concrete factory build-

ing at Newark, N. J., for the American Can Co. By using these and other precautions against freezing the contractors were able to carry on concrete construction in any kind of weather.

The sand and gravel bins which were designed for a capacity of 500 yd. were built with a net work of perforated steam pipes supplied with steam by an auxiliary boiler which also furnished steam for heating the mixing water. Steam was used also for thawing and cleaning out the forms in the same manner in which air or water is often used. Steam was allowed to circulate in the material bins for about 7 hours before the concrete was to be poured and the large lumps were thawed and broken up.

Motor trucks in which the sand and gravel were delivered dumped their loads into the bins through trap doors at street level. The material moved forward on the sloping bottoms of the bins to the front and was discharged into the measuring hopper of the mixer through two gates, one each, for sand and gravel. Cement was added in the hopper and the aggregate passed through another gate into the drum of the $\frac{3}{4}$ yard mixer. The mixer dumped into a bucket at the bottom of the concrete tower and was elevated by an electric hoist to the upper floor where it was dumped into a wooden hopper. The steaming concrete, which was quite hot, was transported in two-wheel carts traveling on runways built on small trestles about 2 feet above the floor.

A Houck concrete heater which heated the aggregate as it passed into the drums and while it was being mixed was attached to the front of the mixer. The heater consisted of a 20-gal. oil storage tank equipped with a powerful hand pump, a pressure gage, a feed pipe, and a vaporizing burner. The burner, which throws out a blast of flame similar to a heating torch, was attached to a steel pipe, oval at the lower end, and bent so that the flame penetrated diagonally into the mixer. About 5 minutes was required to pre-heat and light the burner after which it required very little attention. Sufficient pressure for several hours' operation was attained in a few minutes by the hand pump attached to the oil tank. The gage pressure was maintained at about 50 lb. and the oil consumption was about 2 gal. per hour.

Salamanders were spaced about 25 feet apart and about 10 feet below the floor being poured. They were supported on temporary platforms built into the shoring. The temperature under the floors was maintained at 70 degrees for three days after the concrete was poured. The entire portion of the building being concreted was enclosed by canvas.

The Montreal Portland Cement Co., Ltd., has been incorporated with a capital of \$2,000,000. The promoters of the company state that a site of 52 acres has been secured at Pointe-aux-Trembles, just outside Montreal, and that it is proposed to erect a plant of 5,000 barrels capacity per day, the plans having been prepared. It is further stated that it is intended to manufacture by a new process, involving economies in the cost of making cement and its by-products.

A deputation from the counties of Bonaventure and Gaspé, P. Q., have waited on the Hon. F. Carvell, Minister of Public Works, Ottawa, with a request for financial assistance in improving the roads along the shores of the Gaspé Peninsula.

Steel Bridges Are Standard Throughout Quebec

THERE were 63 steel bridges built in the Province of Quebec during the fiscal year ended June 30, 1918, according to the report of the Minister of Public Works and Labor. At that time there were 46 bridges in process of construction and plans of 68 were being considered, giving a total of 177 bridges coming under the supervision of the Department of Public Works for the year. The total number of bridges built in the province up to June 30th, 1918, was 490, the investment represented being \$3,360,136. The cost of the 46 bridges under way at that date was \$622,461. The illustrations herewith show some of the recently completed structures, the designs of which are typical of those of the new bridges being erected throughout the province.

Typical Quebec Bridges

One illustration shows the bridge over the St. Francois River between the municipalities of Westbury Township and the town of East Angus, Compton County, which was erected in 1918. This view is taken from East Angus and shows two clear spans of 100 ft. each; including the approaches the total length of the bridge is 393 ft. When the photograph was taken there were 26 ft. of water at the centre pier. It will be noticed that the river is completely covered with logs.

The new bridge (Populus Bridge) over the St. Esprit River, between St. Roch L'Achigan, L'Assomption County, and St. Esprit, Montcalm County, was completed in 1918. The bridge has a clear span of 80 ft. and the floor slab is of reinforced concrete carried by the steel truss as shown.

In 1917 the bridge over Riviere Du Loup, at St. Gome de Kennebec, Beauce County, was completed. This splendid bridge has a clear span of 170 ft. and the floor slab is of reinforced concrete.

Advices have been received by Mr. G. T. Milne, Montreal, and Mr. F. W. Field, Toronto, British Trade Commissioners in Canada, that the following additions have been made to the list of goods which may be exported without license: fancy goods made of Morocco and light leathers; iron and steel manufactures generally, except high speed steel and certain special articles; machinery of all kinds except textile machinery and machinery wholly made of brass or copper; toys and dolls; games of all kinds.

Lists of export restrictions recently removed: binder twine, barrels and casks, boilers, chrome ore, chestnut extract cork, fuel economisers for boilers, goldbeaters skin, gluestock, dry white lead, hide clippings, resins, lead coated sheets, paraffin, wax, pigskins, cast iron pipes, iron or steel wire, wire rope, quebracho extract, cast iron radiators, solid glucose, railway sleepers of iron or steel, railway springs, railway wheels, axles and tires, railway constructional material except rails, silk manufactures, spirits except whiskey, turnplates, tinplates.



Bridge over the Riviere Du Loup, at St. Come de Kennebec, Beauce County



Bituminous Surfaces Under Truck Traffic

How May Such Pavements Resist Action of Heavy Motor Trucks? No Efficiency Valuation on Surface if Foundation Fails.

By Prevost Hubbard*

HUNDREDS of miles of roads have failed under heavy motor truck traffic within a comparatively few weeks' or months' time. These failures were not only sudden but complete, and almost over night an excellent surface might become impassable. In the haste and confusion of war activities little opportunity has existed for a systematic and comprehensive study of the problem suddenly thrust upon highway engineers. Reports from all parts of the country have, however, established one outstanding fact which has a most important bearing upon any consideration of the efficiency of bituminous surface and bituminous pavements. A very large proportion of the failures have been characterized by an almost simultaneous destruction of the entire road structure, and not merely the disintegration of the wearing course or pavement proper. No type of pavement will be efficient unless provided with a foundation which will hold up the pavement until it is worn out. When, therefore, the entire structure fails suddenly, inadequate subgrade or foundation conditions are primarily responsible, and but little basis exists for placing an efficiency valuation upon the wearing course.

Inevitably coupled with subgrades and drainage conditions, foundation failures occurring as previously described may be due to one of two causes, lack of thickness, or inability of the foundation structure to sustain the loads without appreciable internal movement. So far as bituminous surfaces or bituminous pavements are concerned, remedy of the first cause does not affect the general type of construction. If, however, present heavy motor truck traffic is to continue and possibly increase in weight as well as volume the second cause may have a direct bearing upon possible modifications in design and in the ultimate determination of the efficiency of certain classes of bituminous work.

Firm Foundation Essential

As there is practically no slab effect produced by the structure of a broken stone or gravel foundation, a load applied to any overlaying bituminous surface is transmitted quite directly to the subgrade. In other words, the intensity of load under its point of application is relatively high throughout the foundation thickness. Under heavy motor truck traffic the intensity of load transmitted through a two inch thickness of dense bituminous concrete to the foundation may be so great as to cause an internal movement sufficient to produce disintegration of the pavement. This is particularly true when the subgrade is of a soft or clayey nature and appears to be quite possible irrespective of any economical thickness of broken stone or gravel foundation which may be used. In general, the experience on heavily travelled city streets has demonstrated the necessity of a slab foundation for any wearing course and there appears to be no reason why such experience should not serve as a

guide for new construction of bituminous pavements on rural highways subjected to modern heavy truck traffic. On these highways the traffic has certainly been as severe as on many city business streets so far as weight of unit loads is concerned and more severe when the high speed often attained by such traffic is considered.

Gravel and Macadam Roads Under Heavy Traffic

With respect to existing gravel and macadam roads, whether or not they have been previously surface treated with bituminous material, it would seem far safer at the present time to attempt to preserve such roads under heavy motor truck traffic by means of surface treatment with bituminous materials rather than to utilize them as foundations for the construction of new bituminous macadam or bituminous concrete pavements. In other words, for the time being, such treatments may prove more efficient than the use of a higher type of pavement placed upon the existing road, although it is clearly recognized that, under heavy motor truck traffic, the bituminous pavements are more efficient, providing the foundation is adequate to support the loads.

Under the same conditions of traffic, bituminous surfaces are most efficient in localities where frost action is either absent or not severe. Such treatments, used in connection with gravel roads in the far south, have given reasonable satisfaction even under heavy motor truck traffic. North of the frost line, and particularly in connection with the treatment of clayey gravel roads which become soft during the spring months, bituminous surfaces are apt to completely disappear. If, however, the gravel road is maintained by dragging and at the end of the thawing-out period is reshaped, thoroughly compacted and again treated with bituminous material, it may be kept in a reasonably satisfactory condition. Under very heavy motor truck traffic, however, maintenance costs may be extremely high so that if a continuation of such traffic is to be expected, the construction of a new road may be necessary.

Bituminous surfaces on properly constructed macadam roads subjected to heavy motor truck traffic may, as a rule, be maintained in localities north of the frost line with less expense and better results than on gravel roads under the same conditions. Such surfaces, under heavy motor truck traffic, cannot be considered as economical from the ordinary standpoint, but may prove the most efficient temporary method of preserving the existing road until money is available for reconstruction. It is believed, however, that under these conditions bituminous surfaces will not even prove efficient unless constantly maintained by a patrol system operating throughout the year.

How Bituminous Macadam Stands Up

With regard to the efficiency of bituminous macadam under heavy motor truck traffic, there are a number of points to be considered. In general, bituminous macadam has not been thought to be efficient for such traffic but, on the other hand, it has almost

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invariably been placed upon a broken stone or gravel base. Aside from character of foundation, it is believed that sufficient attention has not, in general, been paid to the important details of bituminous macadam construction so as to obtain best results. Too frequently the coarse stone is not sufficiently compacted before the first application of bituminous material is made, and later uniform compaction is extremely difficult, if not impossible to secure. Rutting the road with certain types of distributors just prior to application of the material is a common cause of lack of uniformity in compaction, and a strong tendency to distribute faster than the road can be satisfactorily compacted and finished by a single roller is another. Best results from this type of road which have come under the writer's notice have been secured by the hand pouring method, although this method is considered antiquated by many engineers. Where the first application upon the thoroughly compacted coarse stone is made diagonally across the centre line of the road and the second pouring or seal coat is made in a direction diagonally across the first, with proper attention to uniformity of distribution, it is possible to secure a very excellent pavement.

The efficiency of bituminous concrete, sheet asphalt and asphalt block pavements under city traffic is so well understood as to require little comment. If laid upon suitable concrete foundations, there is no reason to suppose that the results given by these pavements in city construction will not be duplicated on rural highways subjected to heavy motor truck traffic. If the foundation is inadequate to support the load, the pavement is bound to fail but, as previously pointed out, failure cannot then be considered a measure of efficiency of the pavement proper.

Materials of Construction

The efficiency of a bituminous surface or bituminous pavement depends not only upon its method of construction but upon the materials composing it. In general, the author's observations and experience has been that the most efficient bituminous carpets are constructed with the heaviest grade of bituminous material which it is possible to apply and make adhere uniformly to the road surface. While on old macadam roads it is advisable to keep the thickness of carpet under $\frac{1}{2}$ inch, on certain types of soft gravel it may be of greater thickness provided a hard and tough coarse aggregate cover of sufficient size to force into the old gravel surface by rolling is used. For clay-gravel or sand-clay-gravel roads north of the frost line it is believed that for maintenance under heavy truck traffic, light superficial treatment with bituminous materials applied cold will prove more efficient than the construction of a bituminous carpet, although neither will be adequate to carry the road through winter.

With regard to bituminous macadam and coarse aggregate bituminous concrete, there is little to suggest in connection with the grade of bituminous materials ordinarily used. It is also believed that more attention should be given to specifying and securing a uniform size, and grading within reasonable limits, of coarse stone for bituminous macadam, in order to promote uniformity in the penetration of the bituminous material as it is applied and to produce a surface that will wear as uniformly as possible.

Harder Grade of Asphalt

In connection with sheet asphalt and the fine aggregate bituminous concretes the tendency to use

harder grades of asphalt cement than heretofore used may prove advisable for very heavy traffic conditions. It is quite possible, however, that better results may be secured by a reduction in the compacted thickness of such pavements with a corresponding increase in thickness of binder courses where one is commonly used. For fine aggregate bituminous concretes which are commonly laid without a binder course, the introduction of such a course not less than $1\frac{1}{2}$ inches thick may prove advisable with a reduction in thickness of wearing course to not more than $1\frac{1}{2}$ inches. Provided the binder course is properly constructed such practice should tend to produce a pavement less susceptible to displacement under heavy motor truck traffic. In any event it is believed that even more attention should be paid to aggregate grading than heretofore in order to produce most satisfactory results.

The resistance to displacement of compacted bituminous aggregates, containing particles from one half inch in diameter down and consisting largely of sand, is mainly dependent upon grading of the aggregate and hardness of the bituminous cement. When, however, the particles become very small and possess absorptive or colloidal properties, neither grading nor consistency of the cementing medium are such important considerations. Very large surface contact and high frictional resistance then become the prime factors. Thus, a fine mastic composed of limestone dust or clay and a very soft asphalt cement may exhibit even greater resistance to displacement than a graded sand aggregate mixed with a much harder asphalt cement. The former type is exemplified by certain finely pulverized bituminous limestones. Use of the latter has but recently passed the experimental stage. It is quite possible, however, that future developments will establish such extremely fine bituminous aggregates as being highly efficient under heavy motor truck traffic for both the sheet and block type of construction.

Letter to the Editor

Picton, Ont., March 15.

Editor, Contract Record.

Dear Sir:—In your issue of March 12th you report Mr. C. R. Marston, of Norfolk County, discussing the resolution of Prince Edward County, which was circulated throughout the various counties, as saying this resolution is a direct insult to the Road Superintendent of Prince Edward County.

In reply to this statement, I would advise you that this resolution was drawn up by the Road Superintendent of Prince Edward County and passed by the County Council on his recommendation.

If Mr. Marston was as familiar with conditions as he should be before making his criticism, he would understand that the adoption of recommendations made in the resolution would go a long way towards correcting the existing evils of road building in Ontario.

Yours truly

(Sgd.) G. H. D. Cleminson
Road Superintendent.

In letting a contract for the construction of a new school, the Catholic School Commissioners of Montreal stipulated that the stone used must be Montreal stone, quarried by Montreal workmen.

Hydraulic Fill Dam Construction

By C. E. Grunsky*

THE hydraulic fill dams already in use sufficiently demonstrate that the construction of dams by the hydraulic fill method has merit. Such accidents as happened to the Necaxa dam in 1909 and to the Calaveras dam in March, 1918, should not be allowed to discredit the method. They serve, however, in giving some definiteness to the limitations to which the method is subject and to the precautions which must be taken to insure a safe structure. The fact that in both of these cases the tops of these dams were at heights of 150 to 200 feet, when the slides occurred, may be accepted, moreover, as good evidence that the construction of high dams by this method is feasible. Probably in neither of these cases would there have been any failure if the progress of erection had been slower, if more time had been allowed for the unwatering of the material of which the dams were being built.

It is obvious to any engineer who has reflected on the problems connected with the serviceability of earth dams that the presence of a certain amount of finely divided material, of which clay is typical, is essential as a component part of the finished earth embankment and that the ideal disposition of this material would be throughout the mass of structure with preponderance at points near the up-stream face so that any moisture that may penetrate through the up-stream portion of the structure will find less and less resistance to its passage as it approaches the down-stream face.

Barriers Necessary

The ideal is more readily obtainable when the method of construction is dry fill than when it is hydraulic fill. The hydraulic fill method of construction requires that provision be made to confine the water with which material is floated into place long enough to let this material settle. There must consequently be barriers erected which will pond the water on top of the dam.

The ordinary practice is to place these barriers along the up-stream and down-stream edges of the top of the dam and let the sluiced material be discharged along these barriers. The coarse material will by this process be dropped nearest to the up-stream and down-stream faces of the dam and the finest, ultimately densest material will be crowded to the centre. In the extreme case in which there is scarcity of fine material it may be advisable to deliver only along the down-stream barrier in order that the finest material may be crowded as far toward the up-stream face as possible, thereby establishing the condition of greatest density up-stream and greatest perviousness near the down-stream face. From this condition to the other extreme of excessive amounts of clay there may be all manner of gradations.

In broad terms the more material there is of the clay type which holds tenaciously to its moisture contents, and which may remain semi-liquid for a long time, the more important it is to flank the same with broad barriers of firm, more or less pervious material, and to allow ample time for drainage. This requirement naturally leads to a concentration of the clayey

materials at or near the central section of the dam which is being constructed by the hydraulic fill process and is apt to accentuate the elimination of coarse material from the clay, particularly in the broad lower layers of the dam where the points of discharge are farther away from the centre than at higher elevations where the dam has less width.

Disposal of Material

Preponderance of clay in the borrow pit or, rather, the presence of clay in undesirable amount, will compel the exercise of good judgment in the direction of the work, so that without sacrifice of imperviousness the pocketing of masses of material which will remain semi-liquid too long may be avoided. The direction of work in such a case relates not alone to a proper disposal of the sluiced material on the growing embankment, but also to a selection in the pit of that which is best suited for use at each successive stage of progress.

The absolute imperviousness of an earth dam is not an essential attribute. We can readily imagine a dam, for example, constructed of material graded from coarse to fine, but without clay in which the fine material in well compacted mass is near enough to the up-stream face and far enough from the down-stream face that it not only sufficiently checks the movement of moisture through the structure, but also gets adequate support from the coarser material. Such a dam, on a suitable foundation, may, even with some leakage, be a perfectly safe and useful structure. In such a dam the line of saturation cannot approach the down-stream face. There will be no danger of sloughing, provided, of course, that proper slopes have been adopted and saturation does not result from other causes such as excessive rainfall upon improperly drained surfaces.

The draining out of the moisture to the surface of the clay mass while a dam is under construction and water is ponded on top will ordinarily be both downward and horizontally outward to the surface of the mass. The clay mass begins to dry, in other words, from the outside. It shrinks in drying, thereby facilitating the movement of moisture from the interior toward the surface of the mass. This movement is the result of the forces of capillarity and of gravity.

Presence of Clay

The greater the dimensions of the wet mass the larger will be the amount of water which must move from the interior to the outside through the outer layers of the mass and therefore the longer will the outer layer be kept wet and the slower will be the rate at which consolidation takes place. The presence of clay in the material of which a dam is being constructed may determine the rate of construction and perhaps, too, the height of the dam that under consideration of all circumstances could be recommended for construction by the hydraulic fill method.

The value of clay as a component part of a dam may be ascribed in large part to its property of swelling when absorbing moisture. A fairly dry compact mass of clay is exceptionally well suited to resist percolation. When its surface is wet as when water rises against a dam, it is probable that this property of swelling with resulting interior pressure prevents deep penetration of the water and accounts for the fact that in the case of dams composed in part of clay or constructed with good clay puddle cores, absolute im-

*Paper read before American Society of Civil Engineers.

perviousness can so frequently be claimed. But the drying of the clay to a reasonable degree of consolidation and compactness is necessary to put the clay into the conditions in which it will properly perform its function and as a general proposition this condition should be obtained before drying is checked by submergence of one face of the dam as when a reservoir is brought into use too soon.

More information is needed relating to the effect of depth of deposit of wet clayey material on the unwatering of the lower layers. Is the upward progression of consolidation due solely to the decreasing rate at which water will flow downward through added depth of material as distance from the ponded water on the top of the dam increases? Or does the weight of the superincumbent material assist in pressing out the water from a confined mass of clay? And what is the relation of the rate of unwatering to depth below the top and to the horizontal distance from the sides of the clay fill?

Answers to these questions when they can be given will be of material service in defining the limitations which are under discussion.

Factors for Consideration

Without endeavoring to make the enumeration complete it may be suggested that among the factors which require special consideration, when the hydraulic fill method of constructing an earth dam is being studied are the following:

1. The suitability of the available material to make a practically water-tight dam when floated into place with water.
2. The relative cost of the hydraulic fill dam when compared with the cost of a dry fill dam.
3. The quality and relative amount of the fine material.
4. The physical properties of the fine material particularly in the matter of giving up the moisture of saturation when accumulated in large masses.
5. The possibility that throughout the mass of the dam local rates of drainage and consolidation will be variable, which may result in so pocketing saturated masses of material that drying out these masses would be retarded.
6. The difficulty of ascertaining the degree of consolidation at all critical points.
7. The interference with drainage and consolidation by the use of the dam for the storage of water before consolidation is complete.
8. The probable settlement that will result from the shrinkage of drying clays.
9. The time required to construct and make available for use.

With reference to the construction of earth dams by the dry fill method it need only be said that when the foundation is suitable and materials are available the only limiting factor is cost.

There will be many cases, particularly in the West, where the suitability of the material for the construction of a hydraulic fill dam is unquestioned. When this is so the main factor to be considered will be the relative cost of the two methods of construction. Because this is occasionally decidedly in favor of the former it has made this type of earth dam deservedly popular.

Determination of Method

Enough has been said to show that the difficulties of construction by the hydraulic fill method and the

uncertainty of what is taking place in the matter of consolidation must increase with the volume of the deposited material. Consequently the problem of determining the method of construction becomes more difficult and grows with importance as the height of the dam increases. It becomes increasingly so when the proportional amount of clay is large and the consolidation will be correspondingly slow.

The use of the hydraulic fill method of constructing earth dams necessarily has its limitations. These limitations can not be defined other than in general terms. Each separate case presents its own problems. In this respect the hydraulic fill dam is on a par with other types of dams introduced at a comparatively recent day, but which have demonstrated their serviceability—such for example as the multiple arch dam—but which also have their limitations. The hydraulic fill dam has already made a place for itself. That this place will be more definitely delineated as further results of experience become available, goes without saying. It is too soon to say that the method is not suitable for any height of earth dam yet proposed.

Railway Commissions Reports on Grade Crossing Situation—Funds for Protective Work Limited

A SMALL section of the report of the Dominion Railway Commission's operations during the year ending March 31, 1918, as tabled by Hon. J. D. Reid, in Parliament recently, deals with the work of the board in administering the railway grade crossing fund in actual construction work on various devices for promoting the safety of those using the highways. On 444 crossings, measures of protection were undertaken, as follows: 241 electric bells, 108 gates, 50 subways, 20 overhead bridges, 20 diversions of highways, three closings of streets, three removals of obstructions to the view of approaching traffic, one shelter and two towers.

The commission feels that the Act has too limiting restrictions. It is pointed out that in the larger cities such works would run into amounts exceeding \$100,000, and occasionally as high as several million dollars, whereas the commission is limited to \$5,000, not to be applied to more than three crossings in one municipality, or more than once to the same crossing. The importance of this protective work is indicated by the report of the board's chief operating officer, which shows that during the past five years there have been 621 highway crossing accidents, resulting in 280 deaths and injuries to 566 persons. Of these, 158 accidents were at protected crossings, where there were 71 killed and 140 injured, and 463 at unprotected crossings, with 209 killed and 426 persons injured. There were 48 automobile accidents at such crossings, in which the casualties amounted to 31 killed and 77 injured, and of these 39 accidents occurred at unprotected crossings, 26 being killed and 58 injured.

The report of the fire inspection department shows that out of 1,097 fires originating within 300 feet of the track, those definitely attributable to railway causes, 240, or 28.46 per cent., expended themselves without doing any damage. The total damage from such fires reached \$105,668, of which the railways are charged with 24.43 per cent. In the Prairie Provinces the railways have constructed 10,994.26 miles of fire guards.

Strengthening Bridges for Truck Traffic

Progress Report of Committee of American Road Builders' Association on Methods of Reconstruction to Carry Heavy Loads

A JOINT committee of the American Good Roads Association and of the National Highway Traffic Association is considering the question of the weights, etc., to be allowed on public roads, and until their report is adopted it may not be advisable to lay down definite standards for determining the necessary strength of old bridges. It may be well, however, to call attention to the following facts: A well-designed, well-constructed, well-maintained reinforced concrete bridge will, so far as we can see, last for centuries. Trucks rated now as heavy may appear puny in 1975. Steel bridges, well-designed, built and maintained will last at least 50 years and probably much longer. The engineer is therefore, using good economy in looking well into the future in designing new bridges because the extra cost of building a bridge of ample strength now is only a fraction of the cost of replacing it with a new one at some future time when much heavier trucks may come into use. If an old bridge is to be strengthened, it is only a temporary makeshift at best and the engineer is not justified in looking many years ahead in deciding on the assumed loading.

Examinations to Find Defects

Every one of the bridges throughout the country should be inspected at least once a year by a competent man. A majority consist of a single span of wooden stringers with plank floors. In the case of such bridges the main points to be observed are the safety of the abutments, the sufficiency of the width, the safety of the railing, the adequacy of the waterway and the strength and soundness of the stringers and planking. All these points require sound judgment and reasonable amount of engineering knowledge. With the larger bridges the responsibility is greater and the danger of loss of life in case of failure is also greater. Many bridges require inspection oftener than once a year. All steel bridges should be painted over every 3 or 4 years by competent men who are carefully instructed to report all defects observed. Many parts of steel bridges are not accessible for proper inspection without the use of scaffolding such as painters use, but it is not always practicable to employ such scaffolding during the annual inspection.

In preparation for the advent of heavy trucks all public bridges should be examined by competent men who will make a record of the character of the traffic likely to come upon the bridge, the dimensions and conditions of all vital members and the sufficiency of the details, and written reports of such inspections forwarded to the proper governmental department for record. From these reports it must be decided which bridges require complete reconstruction, which require new superstructures, and which can be repaired and strengthened. The necessary plans can then be prepared and should be checked on the ground. These inspections should be paid for by the public, preferably on a salary or per diem basis. It should, as a rule, be done by men who are not financially interested in the construction of bridges by contract.

The strengthening of bridges often requires far more engineering skill and ability than the design and construction of new ones. As to how this work of strengthening should be carried out, much depends on circumstances. Estimates of cost are sometimes misleading. Unit costs of repair or alteration work in place are often more than twice the unit costs of similar material in new work. When an engineer starts to repair an old bridge he is almost certain to find a considerable amount of work that must be done that he had not anticipated. For these reasons it is usually best to have the material furnished or fabricated by contract and the field work done by day's work, if a reasonable efficient gang can be organized. Expensive equipment such as pile-drivers, air-compressors, etc., may be rented on a per diem basis. If it is a well-defined job such as replacing a floor system, or an abutment it can be done satisfactorily by contract; otherwise a bidder is confronted by the same difficulty as the engineer in estimating his cost and will either bid high to cover risk and uncertainty, or will bid reasonable prices expecting to make up with his bills of extras, which will be no small item. Often, however, a cost plus contract is preferred, but it must be so worded that it is either to the contractor's interest to furnish proper tools and equipment or he can be forced to do so. It is not always practicable in such cases to insure that the work can be done within the appropriation.

Another difficulty often encountered in a repair job handled by a lump-sum contract may be illustrated as follows: The engineer estimates \$10,000 as an outside figure for the job; he secures an appropriation of \$15,000 to cover extras; the bidders have no way to estimate accurately their cost and are apt to be guided by the amount of the appropriation and bid about \$14,900 leaving far too small a margin for extras. If an efficient gang cannot be organized, the cost plus a fixed sum system is generally the best, except that on public work, public opinion must always be considered and many people have an idea that the cost plus a fixed sum contract is only good for war-work and similar work in which the maximum speed is absolutely necessary regardless of cost.

Variation From Standard Unit Stresses

The committee does not consider that in deciding whether any given member of a bridge needs strengthening, it is necessary to hold strictly to the letter of the standard specifications in the matter of unit stresses. In fact, a deficiency of 20 per cent in material is not serious, provided the details are good and the material is in good condition, it being felt that the usual unit stresses adopted make that much allowance for deterioration, besides secondary stresses, etc. A smaller allowance, however, should be made in the case of floorbeam hangers, stringers and floorbeams which are subject to widely and rapidly varying stresses. In considering the strength of a bridge truss, it is not necessary to assume that the bridge is packed full of trucks of maximum weight, but if the bridge is 16

feet wide or over, it is always possible that two heavy trucks may pass on the bridge.

The committee feels that in cases where the strengthening of a bridge will make it, in effect, a permanent structure, the bridge should be designed to carry a truck weighing at least 20 tons.

The committee fully recognizes that the immediate strengthening of all the bridges in the country that need it, together with the reconstruction of those which cannot be economically strengthened is a physical as well as financial impossibility. It would, therefore, recommend that immediate steps be taken to have a thorough examination made of all important structures by competent engineers, and their safe loads determined and indicated by proper signs to the end that the public be protected so far as is humanly possible. Any person who disregards these notices and suffers disaster has only himself to blame. The work of preparing plans for strengthening should then proceed without delay so that construction will be delayed as little as possible.

Rebuilding Steel Bridges

The small bridges will generally have to be rebuilt. The steel truss bridges will generally be found fairly strong in the trusses, but altogether too weak in the floor system. Many steel bridges have suffered seriously from neglect of painting and maintenance. Very frequently the steel about a foot above the bridge floor is very badly corroded. In such cases tension members would have to be reinforced, which can generally be done if they are of structural shapes, but if the bridge is pin-connected, the bridge can be supported on false-work and new tension members inserted. Corroded compression members can very often be effectually and permanently strengthened by concreting in the corroded parts. The concreting should extend beyond the corroded parts far enough to secure sufficient adhesion. Defective details will generally have to be corrected, even at considerable expense. The attempt is sometimes made to strengthen a truss by placing another alongside it. If this is done great care must be taken that each truss carries its share of the load. The floor system should be supported on falsework and disconnected from both trusses, which swing free and then connections should be made to both the old and new trusses. The upper bracing should be connected to the new trusses also to give them lateral stiffness. If the stringers only are somewhat weak, their number can be increased at quite a moderate expense. If the stringers are very weak, they should be replaced with new ones of sufficient strength. Weak floorbeams can generally be strengthened by riveting on new cover plates. The hangers should be carefully scrutinized for defects as well as for design, and, if necessary, replaced with stronger ones.

Few of the steel truss bridges are strong enough to carry paved floors, although many can be refloored with 2 in. x 4 in. creosoted wood set on edge and spiked closely together. This will give a much more durable floor and one much less liable to break through under heavy loads. The weight is but little greater than that of a plank floor. Plate girders can often be strengthened by riveting on additional cover plates. Riveted lattice trusses can often be reinforced to carry paved floors without throwing away any existing material. Pin-connected trusses can rarely be strengthened and occasions will frequently arise where it is necessary to support the floor by means of timber bents, consisting of piles, if the bottom is soft, or by

means of mud-sills and posts, if the bottom is hard. If these are used they should be placed under all the floor beams, the outer posts being about two feet inside the centre lines of the trusses. This method, of course, is not suitable if the stream is likely to carry much drift wood or floating ice.

Timber, Stone and Concrete Structures

Timber truss bridges can often be strengthened. If, as is frequently the case, the floor only is weak, it is generally possible to put in heavier timber in the floor or to strengthen it with steel to carry heavy trucks. Stone arches are almost always amply strong to carry the load if they are in good repair but it is sometimes necessary to remove the earth covering and grout the joints between the stones to give them a full bearing. Stone arches, moreover, will usually show signs of distress long before total failure. It is rarely possible to strengthen a plain or reinforced concrete arch. If a truss is weak it seldom increases its strength to place bents under the floorbeams unless all the floorbeams are supported in the same way, taking the load almost entirely off the trusses. Plain concrete arches are more liable to fail suddenly without warning than almost any other kind of a bridge.

Personals

Mr. A. M. Turkington has been appointed chief engineer of the Regina plant of P. Burns & Co., the big live-stock and meat concern, succeeding Mr. J. W. Jackson.

Mr. D. H. Fleming, assistant engineer of St. Catharines for the past four and a half years, has been appointed town engineer of Owen Sound, Ont. He takes up his duties April 1st and will supervise the comprehensive scheme of road improvement which is proposed by the board of works.

F. R. Still, vice-president and secretary of the Canadian Sirocco Company, has left on an extended trip for the far east where he will investigate trade conditions in connection with export work. Mr. Still's itinerary includes Japan, China, Australia and most of the European countries. He expects to cover approximately 36,000 miles before returning home about November 1st.

Mr. G. G. Hare, city engineer of St. John, N. B., who succeeded the late Mr. William Murdoch in that position, was born at Kaarsloof, South Africa, but was brought up at St. John. He graduated from McGill University in civil engineering in 1896 and since that date has been engaged in engineering work, principally in Canada—British Columbia, Ontario, New Brunswick and Nova Scotia—also for a time in Mexico and the United States.

Obituary

Mr. Geo. Creford Brown, architect, formerly of Winnipeg, died recently at his home in Brownleigh, South Nyack, N. Y. It is about 15 years since Mr. Brown moved to New York state. He designed many important buildings in Canada, including the Montreal city hall and "Spencerwood," the residence of the Lieutenant-governor of Quebec.

Mr. Harvey Courtright Brice, engineer in charge of the Sumas Lake reclamation scheme in British Columbia, died recently following an operation for stomach trouble. Mr. Brice was born at Brice Prairie, near Onalaska, Wisconsin, in 1862, and in 1904 he went to British Columbia as engineer in charge of location and construction of the V. V. & E. Ry. from Blaine north. He had also been in the service of the G. N. Ry. and was chief engineer for the Western Division of that road previous to taking up private practice. He was the inventor of the railway switch now in general use on railroads.

Industrial Relations—Labor's Viewpoint

Modern Efficiency Methods Deadend Men and Make Them Less Efficient — Labor Wants a Hand in Management of Industry

AT the annual meeting of the Joint Committee of Technical Organizations, held in the Physics Building, University of Toronto, on March 24, a feature was the presentation of addresses on the relationship between capital and labor, by a well qualified representative of each side. The employers' and employees' views on this matter were explained by Mr. J. F. M. Stewart, former secretary of the Canadian Manufacturers' Association, and Mr. Tom Moore, president of the Dominion Trades & Labor Congress, respectively. In this way the engineers and technical men received a balanced elucidation of a subject with which they are closely concerned. An abstract of Mr. Moore's address is given herewith, and in next week's issue Mr. Stewart's paper will be published:

Mr. Moore, in opening, expressed his pleasure at having an opportunity to speak to men and women representative of the phases of industrial activity, which were covered by the organizations they belonged to. In dealing with industry it is very often thought that if you deal with the employers or the labor organizations you cover all those who are interested in the labor problem. However, by the activities of the committee, it has been brought out that there is a third organization interested in this question.

When they first met in Ottawa, Mr. Moore said, it was a revelation to him to know that the engineers were interesting themselves in the social and economic welfare of the workers. Having been in close touch with one of the members of the committee on labor, he had given much more thought to this phase of the situation than he otherwise would have.

Engineers as Mediators

"It seems," he continued, "that the position you gentlemen represent is one of opportunity. In the building industry the architect often has the power of mediating between the employer and the workmen and of smoothing over disturbances that otherwise might arise. What is true of the building industry is equally true of the construction industry where engineers are concerned. Therefore I feel that in addressing this meeting, I have before me more of an impartial jury than is usually the case. It is usual for us to be speaking to men or women who are vitally interested in labor conditions and whose interests do not always appear to fall in with the rest of society. Or, again, when speaking to a gathering of employers, we find a desire on their part to retain their prejudices and make no concessions. So often there is very great difficulty in getting an impartial consideration of the question. I feel that most of those present, however, are aloof from either of these influences, and you can form an unprejudiced opinion as to what is right or wrong.

"Efficiency' seems to have a mechanical sound, but it carries a different inference according to the environment of the man who uses it. In the past it has usually been applied to the perfection of machinery, and it has been used for increasing profits rather than with the idea of improving the conditions of the workers. The employers look at efficiency from the viewpoint of production; labor, from the viewpoint of human happiness and contentment. I believe, however, that all parties are now ready to look at it and

measure it according to the standard of human welfare rather than in dollars and cents.

Men Become Mere Machines

"One of the first steps towards efficiency was in the improvement of machinery to bring about higher production. Then efficiency engineers turned their minds toward perfecting the work of a human being, and the Taylor system and other similar systems were brought into effect. The folly of these systems was that their object was to so perfect the movements of a human being that they became almost as accurate as the machine. In this way they hoped to eliminate any loss of time, and in doing so they succeeded in deadening men's souls and in bringing about that division in industry created by the idea that employers looked upon the workers as merely cogs in the wheels of their plant, and that they had no further interest in a man than the number of movements they could get out of him in a day's work. This ultimately led to the point where, through lack of interest in their work, the workmen became actually less efficient. It was a case of one generation being capitalized at the expense of another.

"Another idea of efficiency introduced in some manufacturing institutions was that of specialization, and instead of teaching a man or a boy all the phases of the trade he took up, the object was to make him as nearly perfect as possible on some special machine. We have seen the results to-day in plants where a man is kept working all day on putting on bolts, or some such operation; or in some of the large abattoirs, where the men stand in a long line, doing the same small operation to each hog as the trolleys pass in endless succession. This system, for the sake of efficiency, is being gradually introduced into industrial establishments. Can you realize the effect on the man who is constantly doing such work? All that a man has to do, day in and day out, and even year in and year out, is, perhaps, just making a cut so long in a hog, until at the end of ten or fifteen years, we find a human being completely deadened.

No Variation or Interest

"Therefore we must take into account these attempts at efficiency in the past and find out where they are leading us to. How much of the industrial unrest of to-day is due to a desire to get away from such slavery and monotony? In the past, when a worker was trained to know all phases of his trade, there was variation and interest, but under the present system, where a man only carries out one little operation, the interest is gone, and such monotony will wear away his initiative and break his spirit. So, in the future, we must look to some system which will remedy some of these defects. Speaking of efficiency from the viewpoint of labor, it is something that should be used for the benefit of the community as a whole—something that should be moulded so that a man can do a day's work and come away as bright and vigorous as when he took it up.

"Regarding the hours of work, I have drawn attention to systems which are deadening to the human mind, and in industrial work of this kind, the hours must be shortened so that between the time of leaving the factory and going back to it, the workers have time to get over its effects. If you keep a man ten hours a day on work of this kind be-

cause he is physically fit for it, you are not looking to ultimate efficiency. In fixing the work-day, due consideration must be given to the necessity for recreation of mind and body. There are many who will say that our grandfathers worked for twelve hours a day, and the men of to-day should be fit for equal labors, but people who make such statements do not give thought to the changed conditions. Therefore the shorter work-day is needed, and it should be shortest in those industries where the monotony is greatest. I would venture to say that Henry Ford may get greater production by a 6-hour work-day, than in a longer period. He evidently realizes that the mind of the worker, as well as his body, must be brought back to the same point, if his next day's work is to be efficient.

Contented Workers are Efficient Workers

"In the mining industry, where a man is shut away from light and carries out his work under lonely conditions, he should be given the shortest possible hours, so that he will have the longest possible time for recreation back amongst other human beings. It is a wise thing to make a survey of the causes of unrest, and it is seen that much of the Bolshevism arises in mining districts. It is not that these workers desire to be destructive, but the conditions of their callings have turned their minds into bitter channels and this is the reason that they are more outspoken and more drastic in their demands than others.

"I believe a man is a reflex of the conditions surrounding him at work and at home. Therefore, if we want a man a good citizen, we must make his surroundings interesting, comfortable and safe. It is impossible to have high production unless you have contented workers, and it is impossible to have contented workers unless the conditions surrounding their employment are satisfactory to the men and women themselves. The hours of labor should not be fixed strictly on the basis of the stamina of the individual, but on the broader basis which considers his welfare and comfort.

"The whole question of efficiency in industry depends on the contentment of the workers, and you can never have contented workers unless some of the inequalities of social conditions are removed. In some cities and housing schemes, workers are being warehoused rather than housed. Therefore, it is the duty of those interested in industry to give some thought to the housing of the workers and lend their assistance to schemes which will again permit the worker to become the possessor of his own home. And not only should we have his own home, but he should also have a little garden surrounding it, where he can find recreation and relaxation from the thoughts of industry. I am convinced that, if the shorter day and proper housing were brought into effect, much of the loss of time which is now occurring, due to discontent, would be removed.

A Hand in the Management of Industry

"There is also a growing thought in the minds of workers that they are separated from the management of industry. If they are to devote their thoughts and minds to greater efficiency, the reward should come to the workers themselves. Industry to-day is not simply the problems of adjusting conditions in individual factories. One industry produces the raw material for another and the whole is a connected chain and must be considered in this light. With the improvement of transportation between one part of the world and another and the drawing together of the different countries, it has become necessary to take cognizance of the world situation. There is a great need of education of the workers themselves in the management of industries, before it can be effectively carried out. We are on the verge of the time when the workers will demand the control of industry and that country which has wisely made provision for the

situation and has given them a growing power will secure the greatest efficiency and contentment. If the employers want to stand back and refuse, I believe in this Dominion steps may be taken, as in Russia, to seize for the workers themselves the means of production. I don't want to see this occur, but an obstinate, stand-pat attitude on the part of capital would bring it about. Workers are no longer content to have industry autocratically controlled as in the past, they are no longer content to be told some morning their services are no longer required. Workers may be unreasonable in this, but you must realize that there is also no justification for the worker who is capable and willing to work being unable to obtain it and earn a sufficient livelihood. There are thousands of workers to-day walking the streets who are just as anxious to be working as they were during the past four years; there are thousands of these people who cannot see and cannot realize why it is impossible to keep them busy and working for the means of production instead of destruction; why their services are not needed for the upbuilding of society just as much as for the tearing down of autocracy. Underlying it all is this feeling that their demands are made not only for themselves but also that they can protect their dependants. If the spirit underlying the demands of these men is one for the betterment of humanity, surely we can forgive them for being drastic.

"I have pointed out this feature of the situation—, that if we are to have efficiency, we must make it impossible for unemployment to exist as it exists to-day. The power must be taken out of the hands of a man or a small board of men to say to thousands that they cannot have work. The workers are saying to-day that this situation must be changed, and if employers will only come forward and institute measures for the gradual elimination of these conditions and for the taking of their employees into co-partnership, the question may be settled amicably. But since the armistice was signed, though demands have been persistently made by labor, there has been very little manifestation of a desire to meet them, on the part of the large manufacturers of this country. Some have waited until the workers have forced the issue, but if labor here were to take matters into their own hands they would be no better equipped to control industry than has been the case in Russia.

Safety and Sanitation

"There is one step in this direction which can be taken immediately. One phase of efficiency must be the elimination of waste—not only waste of material, but also of life. Our industries are destroying thousands of lives, sometimes because of poor ventilation and unsanitary conditions, and also because of the lack of safety devices. There have been innumerable cases where the workers have asked for these improvements and where, because it was thought that it might interfere with the management of the plant, they have been refused, and the first step that might be taken is the placing of safety and sanitary arrangements in the hands of the employees themselves. They know first of anything that is unsafe or unhealthy, and they should be authorized to appoint a committee to install the necessary devices. They might at first bring forward impracticable schemes, but would soon come to realize their responsibility and take only such measures as were necessary and reasonable. Therefore the formation of a shop committee with control of safety and sanitary devices might be a first step towards co-partnership.

"When you thus demonstrate to the workers that you are concerned with their interest and consider the human side of industry, it would afterwards be easy to broaden out the scope of these committees. When the worker is told that there are no more orders on the books, there are two questions he wants answered: Is it because of inefficient

management, or because the employer does not want them on account of their not being sufficiently profitable? You must let the workers know in the future the reason why orders have not been obtained. The employees are often aware of inefficiency of which the management knows nothing. The inefficiency of the Printing Bureau at Ottawa was a revelation to the executives, but the workers themselves had known of it and knew the remedy, but never had an opportunity to put it into operation. If the employers would trust the workers they would find the workers would recognize their responsibility and that they would then have a higher and more efficient class of workmen.

Not So Far Apart, After All

"These industrial councils should be broadened out to the fullest degree, but it is a matter for education. In the annual report of the Joint Committee of Technical Organizations attention was drawn to the fact that, at the recent conference, it had been shown that the labor forces were not as entirely selfish and far apart from the management as had been thought. I have met representatives of capital who were surprised to find not only the intelligence of the workers, but also their adaptation to the new conditions. Much of the trouble of to-day is due to the fact that the employer and the worker have both lived in their own different rooms, suspicious of each other, so that there has always been an attempt to steal an advantage rather than an attempt to better conditions.

"But the co-operation I have spoken of would be wasted unless put to the use of making better the lives of the workers. In the past the employers have been paternal in their measures for the betterment of the living conditions of their employees—they have instituted insurance, pensions, and so forth, and when the employees have asked for increased wages, they have emphasized that they have done this, that and the other for them. This has been a mistake. You must make the worker feel that you are not giving him these things as a measure of charity, and it must be recognized that labor's investment is as great as that of capital, and it is to labor that the first dividends must be paid."

Another step which Mr. Moore said should be taken was the nationalization of transportation, waterpowers and natural resources. The benefit of greater efficiency in these fields should not go to great monopolies, but to the country at large. "When we have brought about this nationalization, co-operation, the short day and the increases of the pleasures of home life, and the raising of the standard of wages until the dividing line between rich and poor has been eliminated, we will then have reached the point that we have been blindly striving for in the past, but the efficiency will not be one of dollars and cents, nor of the unit of production, but of the human happiness you have brought into the lives of the workers of this Dominion."

Trade Publication

How ashes and waste are removed from schools, auditoriums, railroad buildings, apartment houses, hotels, hospitals, etc., by means of the G&G Telescopic Hoist, is described in a series of new pamphlets now being distributed by Gillis & Geoghegan, Sherbrooke, Que. The G&G hoists are made in five styles to suit various conditions. In order that the proper model may be considered in relation to the conditions at any building, readers of the Contract Record are invited to write for pamphlet, "What G&G Model Shall I Use?" obtainable without obligation from Gillis & Geoghegan's Sherbrooke office.

Plans are being outlined for an extensive drainage scheme for the Boundary Bay district in British Columbia.

British Columbia Called Open Ground for Foreign Architects

Another instance in which foreign technical men have been shown preference over Canadian firms on Canadian work, is reported from Vancouver. The work in question is the construction of a new Union Bank Building proposed in that city, which an American firm of architects has been employed to supervise. This manifest injustice to local architectural firms is causing a good deal of dissatisfaction among them, and Mr. S. M. Eveleigh, the B. C. representative on the Council of the Royal Architectural Institute of Canada, on behalf of the local architects' association, has addressed the following letter to the chairman of the Vancouver Board of Trade in this connection:

"As chairman of the Board of Trade it may reasonably be presumed that you desire to advance the business interests of this community and Canadian citizens generally. I therefore call your attention to the manifestly unfair and unpatriotic action of the officials of the Union Bank in awarding the supervision of their proposed new building to a foreign firm of architects.

"This firm is an American firm maintaining an office and casual residence here only when some of our townsmen, who prefer everything of American origin, hand them commissions for buildings. The members of this firm have been recently in the United States army and the legal domicile of themselves and their relatives is in the United States. An examination of their business operations here will show that their sympathies are entirely in favor of the use of material manufactured in the United States, and this statement may easily be substantiated by enquiry amongst local material supply firms.

Question for Advisory Board

"After years of experience, one does not expect very much consideration to be shown to western technical men by head office bank officials, but with the advent of the much-advertised appointment by the Union Bank of a local advisory committee of Vancouver citizens, I think one would be justified in expecting better treatment for provincial architects.

"The persons comprising this advisory committee, I am informed, are members of the council of the board of trade, and as such having many times pledged themselves to the doctrine of 'patronage of home industry,' 'purchase of goods of Canadian manufacture,' 'employment of local labor,' 'the spending of Canadian money in Canada,' and more recently 'employment and work for returned soldiers,' 'reconstruction,' 'Canada for the Canadians,' and other fine-sounding catchphrase platitudes, now find themselves faced with either repudiation of these tenets or the implied admission that their advice to employ local talent has been overridden by the directors of the bank—certainly a disagreeable and anomalous position for newly-appointed officials to find themselves placed—because it is hardly reasonable to suppose the local advisory committee was disloyal enough to recommend to the bank that a foreign firm of architects be employed. The only other position they can take it to disclaim all knowledge of this appointment.

"Open Ground" for Foreign Architects

"You and your council may not be aware that recent legislations in adjacent states prevents any person practising architecture in these states under pain of fine and imprisonment, unless he has resided there for a year and is also an American citizen. The legislature of British Columbia has several times declined to give this protection to the architects of British Columbia, notwithstanding such protection is given to the profession in Quebec, Ontario, Mani-

toba, Saskatchewan and Alberta; so British Columbia is open ground for foreign architects, and the resident architects have therefore the right to claim such sympathy and protection as might be expected would be granted them by members of their home board of trade.

"The usual alien, building-boom, non-resident architect works, for rates that a tax-paying architect, resident of this city could not exist upon. The transient gathers in a few fees and departs, leaving a trail of rotten work behind them—si momentum requiris circumspecte.

Soldiers Could do Work

"Mr. Somervell is a gentleman and a man of standing in his profession and does not work for reduced fees, but is not a citizen or resident of this country, and so I submit is not entitled to receive a commission from the officers of a Canadian corporation. Leaving our own firm entirely out of consideration because the writer was told by one of the general officers of the bank over two years ago that the bank's Winnipeg architects were to do the work here, and consequently had no reason to expect this commission, there are half-a-dozen or more architectural firms fully qualified to design and superintend the erection of any building that the Union Bank, or any other bank, might require. If it is a question of army service—and if the local committee and bank officials are sincere in their protestations of sympathy for the returned soldier—I wish to inform you that there are two or three officers who have fought in the trenches, architects by profession, resident in the province, recently returned from France, who are also well qualified to carry out the bank's work.

Encouragement of Home Industry

"It seems to me that if the oft-preached doctrine of 'patronage of home industry' means anything more to the members of the Board of Trade than a nice-sounding phrase, you will be able to see your way clear to recommend to one of your bureaux the consideration of the subject matter of this letter, and request an expression of opinion thereon.

"I have been informed that a letter addressed to the Board of Trade, in which the action of a bank is criticized, is suppressed, no matter how detrimental such action may be to any group of citizens. I can hardly conceive this information to be true. However, the result will prove or discredit this statement."

Trade Incorporations

Canadian File & Tool Works, Limited, capital \$200,000, Montreal.

Harrison & Lammond Construction Co., Ltd., Vancouver, capital \$50,000.

Crammond Machinery Co., Ltd., capital \$50,000, head office Montreal.

Kamloops Building Syndicate, Ltd., Kamloops, B. C., capital \$20,000.

Montreal Portland Cement Company, Ltd., capital \$2,000,000, Montreal, P. Q.

La Compagnie des Terrains de Vimy, capital \$150,000, Montreal, to carry on real estate and construction business.

Ottawa Estate & Investors, Limited, head office Ottawa, capital \$60,000. Authorized to carry on the business of contracting and construction.

P. H. Secords & Sons Construction Co., Ltd., capital \$500,000, Brantford, Ont., to take over business of P. H. Secord & Sons, Limited—authorized to operate as general contractors, engineers and architects.

Mainly Constructional

East and West—From Coast to Coast

A housing commission has been formed in Galt, Ont.

The Prince Rupert Drydock & Engineering Co. is planning to build two 21,800-ton steel ships at Prince Rupert, B. C.

The Galt Art Metal Company, Ltd., Galt, Ont., plan the resumption of business on a pre-war scale and the employment of additional hands.

The Great War Veterans Association has a campaign underway to raise \$90,000 for the erection of a central executive building in Regina, Sask.

The two most important construction items included in the estimates of the B. C. provincial government are: Johnson street bridge, Victoria, \$200,000; Boy's Industrial School, Vancouver, \$75,000.

The Board of Trade of Preston, Ont., recently passed a resolution recommending that the town council make application for the sum of \$150,000 for the purpose of erecting houses under the Ontario Housing Act.

The city council of Sault Ste. Marie, Ont., has appointed ex-Mayor W. J. Thompson and former City Engineer A. G. Tweedie members of a housing commission for that city, with Mayor M. A. Boyd, ex-officio member.

A million-dollar factory is to be built in Vancouver, B. C., by the Coca-Cola Company, at the corner of Richards and Smyth streets. One storey is to be erected at present and provision made for the addition of two storeys later.

The Miramichi Construction Co., Ltd., a newly organized concern, is taking over the assets of the International Shipbuilding Corporation, including their yards at Nordin, N. B., plant, machinery, stock of material and a 540-ton schooner which was being built when the corporation ran short of capital.

Reduction in the freight rates on building materials is advocated in the United States as a means of decreasing the cost of building and is understood to have met with the approval of the Director-General of Railroads. This step is intended to bring about an awakening of activity in building and construction.

Among the construction undertakings which the Halifax Shipyards are stated to have in view are a plate mill and a machine shop. The plate mill is to cost about \$250,000 or \$300,000 and will be of reinforced concrete. The machine shop, which will be the second to be built by the company, will cost about \$70,000.

The Kitchener and Waterloo Manufacturers' Association, which is an amalgamation of the Employers' Association, the Kitchener manufacturers and the Waterloo manufacturers, proposes to take steps to secure the erection of more houses for working men in these communities, and the provisions of the new Housing Bill will be investigated.

Repairs are about completed to the furnaces of the Nova Scotia Steel & Coal Co., at Sydney Mines, N. S. Operation of one rolling mill was resumed a week ago and the other mills are to recommence work within a few days. Plans for a complete reorganization of the company's plant are being worked out and a statement of development is expected within a few weeks.

The Roman Catholic church at Gravelbourg, Sask., the basement of which was finished last year and was used as a church edifice, is to be brought to completion this year. This

building, for which J. H. Tremblay & Sons, of Winnipeg, have the contract, will cost over \$100,000. A \$100,000 R. C. college and a \$50,000 hospital for the Grey Nuns, are also to be built in this town.

The announcement that the management of the Government railways proposes to call tenders at once for 250,000 ties to be used in connection with the further construction of the Hudson Bay Railway, would indicate that work on that road is to be pushed ahead this season. This appears to be the result of representations by Western members of the Parliament. It is stated that the line will in all probability be completed before the end of the summer of 1920.

Over \$1,000,000 worth of construction work is proposed in Kingston, Ont., half of which is to be done by the federal and provincial governments. The provincial government is expending \$75,000 in building extensions at Rockwood Hospital. The Kingston General Hospital is to be enlarged and the Douglas Library and possibly other buildings started at Queen's University. There is also the new educational building for the Royal Military College, for which tenders have been received already.

Premier Oliver, of British Columbia, has announced that the Provincial Government will at once introduce a bill to provide for the borrowing of three and a half million dollars for the important public undertakings in the province during 1919. Part of this sum will be devoted to an emergency fund of one and half million dollars for the purpose of providing work for returned soldiers. Practically the whole of this amount will be for capital expenditure on public works in the province, chiefly trunk roads.

In order to develop the community spirit in the province, the Ontario Government proposes to give financial aid to townships for the establishment of community-halls and athletic fields. Legislation for this purpose was recently introduced in the Legislature by Hon. G. S. Henry, providing for a government grant of 25 per cent. of the cost of constructing a community hall, with a maximum grant of \$2,000. This grant will be made on the value of the building alone, and in addition to the site, the local interests must provide a suitable athletic field.

Plans are being pushed ahead in Burnaby, B. C., in connection with the housing scheme for returned veterans on the government lands known as D. L. 71 and 72. This area is to be divided into half-acre lots, and the land will be cleared; streets graded, water mains extended from the existing water system in Burnaby, and electric light, power and transportation facilities will be provided. Modern houses will be erected and the cost to the returned men will be \$2,200 for the dwelling and the lot; payment being extended over a period of twenty years.

Ten miles of the main channel will be constructed this season on the government irrigation project in the Osoyoos district, B. C. The work will be completed in units and water will be made available for the lands in the adjacent area as each unit is finished. Already camps have been established. This channel will be constructed on the gravity principle and the water will be supplied from the Okanagan River, but later storage and reservoir systems will be built in the hills behind the property and irrigation will be made available for the whole area. Mr. F. H. Latimer, of Penticton, is engineer in connection with the project.

A conference of some twenty delegates of cities and towns of Saskatchewan with members of the provincial cabinet was recently held in Regina to discuss the housing question, and it was decided that the federal government's scheme was not practicable so far as that province was concerned. It was pointed out that Saskatchewan's share would be \$1,716,000 with which at the most not more than 500 houses

could be secured. Under these conditions it was thought it would not help to solve the problem and would only act as a deterrent to private capital. Finally a resolution was unanimously adopted to the effect that the provincial government in co-operation with the other provincial governments of the West strongly urge the Dominion government to assume all responsibility in financing housing schemes, the municipalities being made responsible only for administration.

The proposed educational building at the Royal Military College, Kingston, Ont., for which tenders were recently received, will be located on the west side of the present educational building and just a few feet from it. The two buildings will be connected, for the present, by a passageway, but it is intended later to reconstruct the old building to conform to the new one, of which it will form a part. The new structure will be 158 ft. x 106 ft. and there will be an assembly hall adjoining, 67 ft. x 65 ft. It will consist of basement and three storeys. The basement, in addition to the machinery room and heating plant, will contain the applied science branch. The ground floor will contain the main hall, lecture room and six rooms; the first floor, main hall, lecture room and six rooms; the second floor, the laboratory and five other rooms. The building will be of stone and a 105-foot tower rising above the main entrance will give it a very imposing appearance.

GOOD ROADS ACTIVITIES

The Board of Trade of Vernon, B. C., is continuing its agitation to have the necessary repairs made to the road between that city and Armstrong. A committee has been appointed to take the matter up with Road Superintendent Dever and the district engineer.

An amendment has been made to the New Brunswick Highway Act requiring owners of tractors to obtain permits and give bonds before they can be used upon the highways.

The Board of Trade of Kelowna, B. C., has passed a resolution urging that the provincial government build a road between Kelowna and Carleton Place to connect with the Boundary district.

Mr. A. McGillivray, Highway Commissioner for Manitoba, estimates that there will be approximately one thousand miles of market roads built in that province this year, and believes it will be the busiest road building season the province ever had. "Good Roads" programmes have already been prepared by many municipalities and others are under consideration. The following municipalities have already submitted by-laws involving the expenditures mentioned. These amounts in each case will be duplicated by a government grant: Rockwood, \$224,000; Woodworth, \$200,000; Miniota, \$225,000; Archie, \$40,000; Franklin, \$50,000; St. Clement, \$38,000; Oakland, \$60,000; Glenwood, \$40,000; Grey, \$50,000; Swan River, \$108,000. A large number of bridges will also be built this year, the majority of which will be of reinforced concrete.

Commissioner McGillivray also hopes to see a lot of work done on the Jefferson highway from Winnipeg to Emerson. The engineers are preparing estimates of cost of the road for the municipalities through which it passes and a joint meeting of all parties concerned will be called soon. It is believed that the road will cost on an average \$4,500 per mile, with 67 miles to be constructed. Two-thirds of the cost of construction and up-keep is to be borne by the government and the balance by the municipalities concerned.

The main highway through Portage and Brandon to the Saskatchewan boundary is also to be proceeded with. One hundred and forty-one miles have already been constructed, leaving about ninety miles yet to be built.

Boost, Not Knock, Good Roads, said H. T. Routly at Eastern Ontario Good Roads Association

I COME here as one of the charter members of your association and instead of making my first public appearance as Construction Engineer for the Department of Provincial Highways, I really am making my last appearance—for a time at least—as a free-lance contracting engineer, and I would ask you to interpret my few remarks as such.

I have always been interested in roads—one of the first positions ever offered me in charge of a body of men was in charge of road cutting for a lumber company in South-Eastern Manitoba many years ago.

In my University course in the Faculty of Applied Science in Toronto, my thesis was written on road construction, but I hope that this document is so far buried that it can never be resurrected to be held against me. I haven't the faintest idea now what is in it, but it was written at a time when a wealth of inexperience gave me great confidence and permitted me to say many things and to hold many positive ideas that years of subsequent actual experience may have entirely disproved.

Dogmatism Deprecated

In fact the last ten years of constant touch with road matters—particularly from the road engineering and contracting point of view—have taught me above everything else the danger of forming fixed and dogmatic opinions regarding road matters. I meet constantly men in various lines of professional or business life who express such unqualified, positive opinions regarding what ought to be the policy of this or that government regarding road construction or regarding what type of road is the most suitable for this or that location, that I am fairly astounded. I sometimes respect I envy such men their self-complacency—and the unbounded confidence they have in the correctness of their opinions. But men of such type are entirely unfitted to deal with the road problems of the present day. It is a question on few points of which we can afford to be dogmatic. New conditions are arising and developing so rapidly and have such a tremendous bearing on the question of road policy and road design that the only men qualified to handle the proposition are men who never close their minds to the influence of new ideas—new methods—new experience—but who are ever ready to see, to study, weigh and if deemed advisable, to adopt, and to gain from the experience of others as they go along. By that I do not mean that those in charge of road propositions should willy-nilly be swayed and turned by every new theory and diverted lightly from a carefully prepared programme. But they should ever be ready to assimilate new ideas and to adopt new methods or materials, the use of which has been justified by the experience of themselves or others. It may be claimed—and by many will be asserted—that we, as engineers, should be able to build "Permanent Roads"—roads that will last indefinitely and give continuous satisfaction. Gentlemen, when you can tell us just what the type and density of traffic will be on a given road, we will undertake to design a road at minimum cost which will give maximum efficiency. This magnificent building in which we meet is entirely satisfactory, we will say, at the present time, for the traffic it has to bear. But

if its owners decided that it was too small and undertook to provide for the double accommodation by adding another 6 or 8 storey—do you think the original designers should be held if the walls should crack and the building rapidly go out of repair because of the imposition of a load its foundation were never designed to bear.

Period of Uncertainty

We are just now passing through a period similar to that which occurred during the development of steam railroads. I refer to the constant struggle of engineers who designed the road bed—the rails, the bridges and other structures—to keep abreast of the engineers who were designing the locomotives. The roadbed and structure designed to carry 40-ton locomotives failed under 60-ton locomotives, but when the authorities put it up to the roadway engineers to build structures for 60-ton engines, they were quite equal to the task. But then locomotive engineers designed a still heavier locomotive and so the race went on until a point was reached where economics decided that the race had gone far enough and now the design of railroad structures is practically stabilized. We are experiencing a similar period of uncertainty in highway construction, and while certain men of limited local knowledge will express positive final opinions regarding what should be done, I can only say that the brightest and brainiest men in America today are struggling with this problem and have not yet reached their final conclusions. But these are of the same type, class and profession of men who successfully met and mastered the German war machine and you can rest assured they will meet and master this highway problem. And with the help of legislation putting, for the time being at least, a limit upon the loading and speeding of trucks, cars and road engines, you can rest assured that the engineers of the various highway departments can design roads which will give what you have a right to expect—good value for your money. And I am sure we were all pleased to note in recent pronouncements that the governments are at last prepared to furnish sufficient funds to permit of the construction of a type of road suitable for all present traffic and with a reasonable margin of safety to provide for such future traffic as we can now foresee. And so I feel every confidence in assuring you that the programme of the Ontario Highway Department contemplates the providing of roads of such permanency that the future maintenance charges will be a minimum.

I take this first opportunity to voice my appreciation of the honor and confidence placed in me by the Government in tendering me this appointment. It has often been remarked that positions of this character are handed to persons of little or no practical experience, who by reason of political pull exert such influence as to secure their appointment. I wish to state that my appointment was not obtained in this manner, but has come, I believe, in recognition of my small success as a roadway engineer and my reputation as a road contractor, and I value and appreciate it as such. It will be my constant endeavor to so conduct my work that the confidence thus extended to me will prove amply justified and lead to further recognition in this manner of the members of my profession, when future appointments of an engineering nature are being made.

I wish to thank you for hearing so patiently these remarks, rather hastily and loosely prepared since ar-

iving at the convention, I wish to ask for your friendly co-operation and assistance. If you have criticisms to make of my department please make them in the first instance to me and if they are made in a friendly spirit of constructive co-operation I shall be very grateful. Criticisms there will naturally be—especially of anyone having to do with the design or construction of roads. I ask you to suspend final judgment in all cases until you are possessed of all the facts. If then you are unable to agree, I still ask for your co-operation, for if in your judgment we may not be doing the very best thing, perhaps you will be able to concede that we are doing the second best and therefore still worthy of your strongest possible support pending the time when your ideas are examined and possibly adopted. We all want to see the Good Roads' scheme develop and extend—so boost, don't knock.

Applying Stucco with the Centrifugal Stucco Gun

A RECENT and somewhat difficult job was carried out successfully with the centrifugal stucco gun. The building was constructed with studding put up on the same principle as for a frame house. The studding was fluted out on each side and concrete poured between. After the framework had been removed a very thin coat of plaster



Centrifugal stucco gun applies stucco to old plaster

was put on before the timber had absorbed all the dampness it was possible to absorb and, as a consequence the plastering cracked opposite each piece of studding. It was decided to cover the timbers with a coat of stucco. The walls were completely cleaned of all dirt and foreign matter, and were wet by means of a high pressure hose. This was done twenty-four hours before applying the cement mortar. The walls

were again wet a few hours before the stucco was put on. These wettings saturated the timber so thoroughly that it was impossible for it to expand any more from the dampness of the stucco. Two machines were used in applying the stucco and each machine had an operator at 70 cents per hour and a helper at 45 cents per hour. In addition to this one man was employed at 45 cents per hour in mixing the material. The labor cost of applying the stucco was 15 cents per square yard. The sand cost was \$3.00 per cu. yd., or 2 cents per square yard of stuccoed surface; the cement cost was \$3.20 per bbl. or 6 cents per square yard of surface. The total finished job was, therefore, 23 cents per square yard.

Money for Road and Bridge Work in Saskatchewan

THE following information relative to amounts voted for highway and bridge construction in the Province of Saskatchewan, has been submitted by Mr. H. H. Carpenter, Deputy Minister of Highways:

Chargeable to income—

Roads and bridges, including aid to rural municipalities	\$600,000
Ferry accommodation	115,000
Surveys	45,000

Chargeable to capital—

Construction public highways	\$335,000
Permanent bridges	220,000

With reference to the above the \$600,000 for roads and bridges will be used for the construction and maintenance of timber bridges and maintenance of roads. This work will be under the direct control of the department. From this item will also be paid grants amounting to about \$150,000 to rural municipalities to be used by them for the maintenance of highways. Of the amounts chargeable to capital the \$335,000 for the construction of public highways will be administered by this department. The \$220,000 for permanent bridges will also be administered by this department and provides for the construction of steel bridges on concrete abutments or reinforced concrete arch bridges. It is expected at this date that probably all of the above amounts will be used.

Cut in Steel Prices

After several meetings between the Government Industrial Board and the steel manufacturers, a cut of approximately seven dollars per ton on steel bars, plates and structural shapes has been arranged. The reductions run from ten to fourteen per cent. on all lines. Judge Geary, of the U. S. Steel Corporation, states that these prices will hold for a year and will not mean any reduction in wages. No cut in the price of pig iron f.o.b. Lake Erie ports is announced.

The following have been appointed directors of the Canadian Good Roads Association, on the nomination of the respective governments; British Columbia, Mr. J. E. Griffith, Deputy Minister of Public Works; Saskatchewan, the Hon. S. Latta, Minister of Highways; New Brunswick, Mr. T. P. Regan, president of the New Brunswick Auto Association, St. John.

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and Engineering Review

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Why Not Open Bidding on Building Contracts?

A FEW days ago tenders were submitted on a building job running into some \$20,000. The lowest competitive tender was close to \$4,000, the highest about \$7,500—a discrepancy of 87½ per cent. In the other trades the difference, though not quite so great, was still far from indicating that there was any definite system in the method of figuring these tenders. One thing, however, was plain—either the low tender meant a loss, possibly a very considerable one, or the high tender meant an undue profit. Whichever it was, though, the owner saw only the one possibility—all the tenders were too high except the lowest. Indeed the lack of uniformity in the amounts gave him the impression that the contractors were all pretty much guessing and that probably even the low tender was away too high.

What an unsatisfactory condition, after all, this is, to exist in the building trades—making a living by averages—losing money on one job and making it up on the next. Surely it is a condition that can be remedied.

In various parts of the continent the solution of the difficulties noted above has been found in what is known as the "Open Price Plan." Briefly stated it is simply an exchange of figures among the contractors who submit tenders on any piece of work. That is, suppose there are three sub-contractor carpenters who submit tenders on a job for \$2,000, \$2,500 and \$3,000—no other tenders submitted—the plan provides for giving each of these sub-contractors the figures submitted by the other two just as soon as these tenders are in. Then what happens? Sub-contractor No. 1 sees that he is \$500 lower than No. 2 and \$1,000 lower than No. 3 and says to himself, "I wonder if I've made some mistake." He then goes over his figures more carefully and finds, perhaps, that he has omitted certain details. Contractor No. 2 gets thinking too, and perhaps calls up No. 1 and they compare items. Finally No. 3 says to himself that these other fellows surely must have some secret of doing business cheaper than he can do it, and so on. The net result is, as has been shown by experience, that they all get together with their legs under the same table and "talk things over."

Where this plan has been given a fair trial, it has been shown to have two very definite results:

1. When the contractors get together to discuss their items and figures, there is finally evolved a "system" of computing costs which cuts the discrepancies between the various totals from the present general percentage of anywhere from 50 per cent to 100 per cent down to 5 per cent to 10 per cent, and

2. The contractors can no longer, having this information, be played against one another as is so often the case at present.

There are other advantages, too. For example, much money is now spent in useless competition—a dozen contractors are asked to bid, unknown to one another, when two or three tenders would be quite sufficient. In a job in New York city not long ago, a piece of work costing \$41,000 was tendered for by some eighteen or twenty contractors and it was afterwards shown that the actual total cost to all these contractors, of merely preparing specifications and submitting tenders was about \$43,000, or \$2,000 more than the value of the job itself.

We submit the above rough outline of this scheme for the consideration of Canadian contractors. In these days of high cost of everything we cannot afford to let any reasonable looking remedy go by without trying it once. If it works well in other places, why not in Canadian towns and cities?

The Quebec Act for the Construction of Industrial Houses

THE Quebec Act for the construction of industrial dwellings, as finally passed, provides for the allocation of the share of the Federal grant according to the population of the province. The Minister of Municipal Affairs is authorized to prepare a general scheme of housing for the province, to appoint a director of housing, and to advance to the city and town municipalities of the province such sums of money as he may deem fit, providing that a by-law is passed to the effect that the money is required to purchase land, to construct local improvements necessary to facilitate the carrying out of a housing scheme, and to build, or to ad-

vance to persons who desire to build, in conformity with the Act.

The loan to a municipality is to be made for 25 or 30 years, at 5 per cent. interest. Every municipality coming within the scope of the provisions of the act is authorized to itself acquire land, by expropriation or otherwise, and build, by contract according to the ordinary rules for municipal works, dwellings within the boundaries of its own or adjacent territory; to advance the money it has itself borrowed from the Province to persons who make application therefor for the purpose of erecting houses; and to make such advances to housing companies.

The cost of any dwelling built under the act must not be more than a total sum of \$4,500, including the value of the lot. The value of the lot must not be more than one-sixth the cost of the building, except where such lot is provided with local improvements to the satisfaction of the municipality, in which case the value of the lot, plus the value of the local improvements, may be one-fifth the value of the building.

The Act also provides that not more than 80 per cent. of the total value of the building and land can be lent to private persons or 85 per cent. to housing companies. Money may be advanced by the municipality for 20 years for necessary local improvements or buildings, costing from \$3,000 to \$3,500, and 30 years for buildings costing from \$4,000 to \$4,500. The former class may be detached or semi-detached dwellings with walls constructed wholly or partly of frame with stucco, or frame with brick veneer, the cost to be inclusive of the value of the site and the necessary local improvements. The second-class may be detached, semi-detached, groups of three or more, or duplex (cottage flat) dwellings, with walls of brick, hollow tile, stone or concrete, and roofing of fire-proof material.

Every municipality is authorized to appoint a commission of at least three members, or a director of housing, for putting the act into operation, supervising the construction, etc., but any remuneration must not form a charge on the loan for housing purposes. Every building scheme, including the plans and specifications, will be subject to the approval of the Provincial Director of Housing.

Ontario Fire Prevention League's Educative Campaign

THE Ontario Fire Prevention League, in affiliation with the Ontario Fire Marshal's Office, has published, and is distributing a booklet, "Fire Prevention on the Farm and Elsewhere." Propaganda of the nature contained in this little publication, if persistently spread, should be productive of good results. The appeal, very properly, is made to the individual and the necessity of carefulness on the part of each member of the household is urged. Attention is drawn to our enormous fire waste, and many careless habits and practices in which conflagrations frequently find their inception, are pointed out. Two out of three fires, it is stated, occur in our homes. There are many items of particular interest to farmers: Lightning rods—their efficiency and installation, by W. H. Day, Professor of Physics, Ontario Agricultural College; Electricity on the Farm, by H. F. Strickland, Chief Electrical Inspector, Hydro-electric Power Commission; Prevention of forest fires, by E. J. Zavitz, Provincial Forester of Ontario. There is

also a great deal of information regarding the causes of fire and instructions for their prevention, which are of interest to all patriotic citizens. Mr. E. P. Heaton is Fire Marshal for the Province, and Mr. Geo. F. Lewis is Deputy Fire Marshal and also secretary of the Ontario Fire Prevention League.

Programme of Convention of Clay Products Association in Montreal

THE executive of the Canadian National Clay Products Association have arranged the following programme for their convention which is to be held in Montreal, May 26-28:

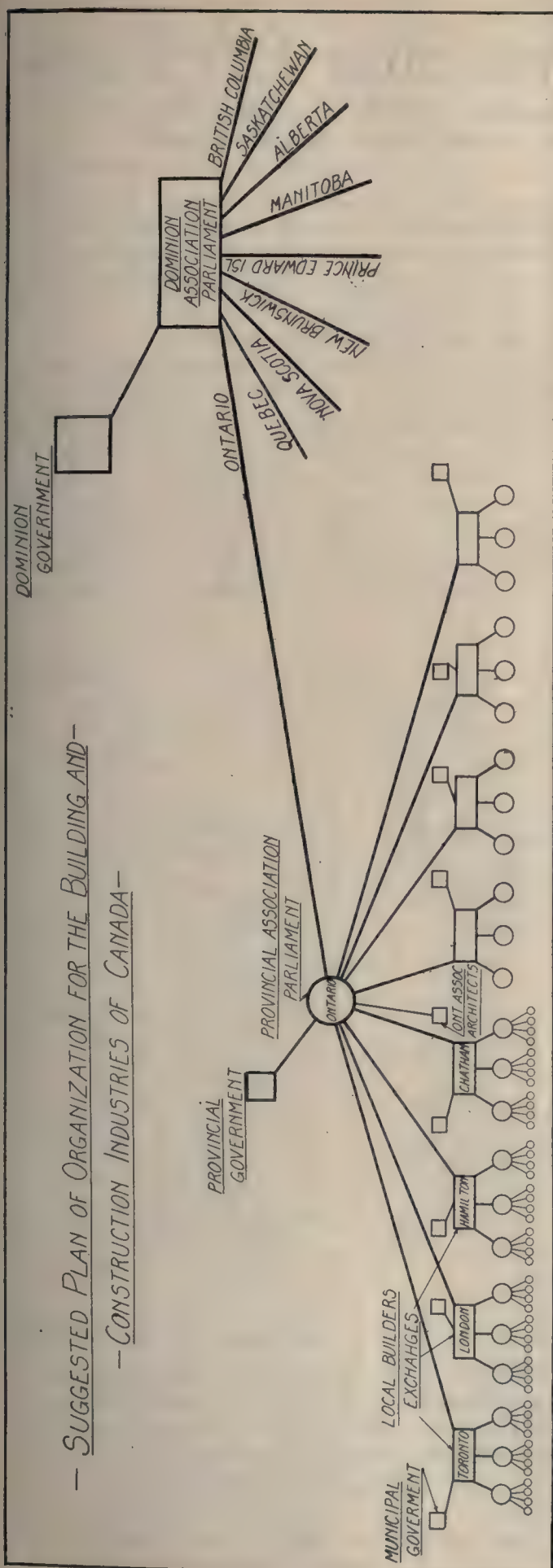
"Why Freight Rates Are as They Are and How Made," by Jas. E. Walsh, General Manager of the Canadian Manufacturers' Association.

"Transportation of Clay Products," by Millard F. Gibson, General Manager of the National Fireproofing Company; "Use of Firebrick in the Steel and Clay Products Business," "Sewer Pipe Investigations," by A. G. Dalzell; "Firing of Clay Products in the Dressler Continuous Muffle Kiln," by Conrod Dressler of the American Dressler Tunnel Kilns Co., New York; "Steam Shovel Comparisons," by Wm. Burgess, Superintendent of the Don Valley Brick Works, Todmorden; "Motor Trucks in the Clay Products Business," by Chas. Harrison and Horace Harpham; "The Burning of Carbonaceous Clays," by Joseph Keele, Chief Engineer of the Ceramic Department, Mines Branch, Ottawa; "Brick Tests and Investigations," by W. W. Pearse, City Architect, Toronto; "Machinery and Dryers for Large Size Tile," by L. Haigh, American Clay Machinery Co. Messrs H. H. Hallatt, chairman of Tile Committee, and M. F. Gibson, chairman of the Technical Education Committee, will give their reports. Thomas Kennedy will give the President's annual address.

Opposed to Building of Houses by Municipalities

A T a public meeting recently held in Winnipeg to discuss the housing question, the general opinion expressed was opposed to the municipality going into the building of dwellings for returned men and the loaning of the money to the individual soldier instead was favored. A resolution was also passed declaring that the offer of money to municipalities at 5% was totally inadequate to meet the present conditions and requesting the provincial government to petition the Dominion government to assume greater financial responsibility towards building. "We are further of opinion," it stated, "that as the Dominion government is helping the soldier who is going on the land, that the soldier who is going to make his home in the city should receive direct aid from the government by subsidy."

It was stated by Mr. Percy Over that the Architects' Association were ready to co-operate in any scheme adopted, and that the great majority of the architects of the city had prepared plans for three types of buildings—single cottage, double cottage and terrace. The walls would be of brick or tile covered with cement stucco and the shingles would be of asbestos. Although there had hardly been time for close figuring, estimates had been received from firms which had experience in this class of construction work. The prices were based on 12,000 cubic feet for



the small cottage. The lowest estimate received for the single cottage was \$4,000 each; in groups, \$3,700; double cottage, each \$3,800; in groups, \$3,500; terrace, \$3,600; in groups, \$3,300. These figures do not include the price of the land.

Getting the Building Trades Organized

THE work of organization of the building and construction industry throughout the Province of Ontario is being pushed forward. Mr. H. Elgie, president of the Provincial Association, has just completed the mailing of a very interesting letter, which we print below, so that it may have the widest possible publicity. Mr. Elgie also enclosed with his letter a copy of the organization scheme which he has had drawn up and which, so far as we can learn, is strongly appealing to the contractors. We are also reproducing this suggested plan and would be glad to hear from any of our readers who have suggestions or criticisms to offer. The following is the letter:

Dear Sir:—

Have you thought of the advantages of organizing the building and construction industries in your community or town? It is the second largest industry in Canada. Now that the war is over, should we not get together and improve the condition of the industry that is, or should be, so important to us, and the community in which we have opportunity to better conditions.

Let us face the great work of readjustment. The immediate essential thing is to get together and formulate a line of action or procedure.

At the recent convention of the Provincial Builders' and Supply Association of Ontario, held in Chatham, it was decided to make an effort to develop the organization of the Province. A strong Provincial organization is made possible through the strength of local or district exchanges, and it is in an endeavor to establish and strengthen the work in your district that we are asking your earnest co-operation.

We would ask you to get in touch with the men interested in the industry in your locality, with the idea of forming a local exchange or enlarging the scope and usefulness of any existing association. On advice from you, or your exchange, an officer from the Provincial Association will be pleased to visit you for the purpose of assisting in the work of organization.

Trusting that you will use every effort to arouse enthusiasm in this work, we remain at your service.

Yours very truly,

T. P. Wright,

Secretary-Treasurer,

London, Ont.

H. Elgie,

President,

Toronto.

The plastering contractors' section of the Toronto Builders' Exchange has made an agreement with the laborers as to wages for the coming year. The rate, effective from May 1 next to March 31, 1920, is to be 55 cents an hour.

Effective to March, 1920, the rate of wages agreed upon between the plastering contractors' section of the London Builders' Exchange and their plasterers is 62½ cents an hour. The laborers receive 45 cents an hour.

line 19 miles in length; the poles were cedar, 30 ft. long and 8 inches diameter at the top, spaced at 104 ft. and carrying one two-pin crossarm and a ridge pin giving a 28 inch triangle. The conductors were No. 4 h.d. bare copper. A No. 10 iron wire telephone circuit transposed every 5 poles was also provided five feet below the high tension. The high tension conductors were not at that time transposed so that the telephone was always noisy.

Temporary Tie Line

Mr. Greenwood, shortly after his appointment as engineer in 1910, prepared a report on the power plant and, after investi-

insulators. A 5-16 inch seven strand galvanized steel ground wire was strung on the tops of the poles to protect them from lightning. A No. 10 copper, h.d. telephone circuit was also strung. At the same time, 1911, a second transmission line was built from Ragged Rapids to Orillia. The same construction was used except that No. 2/0 aluminium was used for conductors. Telephone was transposed every five poles. The high tension conductors were also transposed three times between Big Chute and Ragged Rapids and nine times between Ragged Rapids and Orillia.

New Plant in Connection With Canal Development

When the plans for the Trent Valley Canal were finally adopted it was proposed in order to avoid heavy expense in rock cutting, etc., to pass the Ragged Rapids dam, to wipe out the Ragged Rapids dam and power house and to build a new dam and lock some two miles further down stream at Swift Rapids and to incorporate in the work a new power-house.

This plan was agreed to by the town of Orillia and a contract was awarded by the Department of Railways and

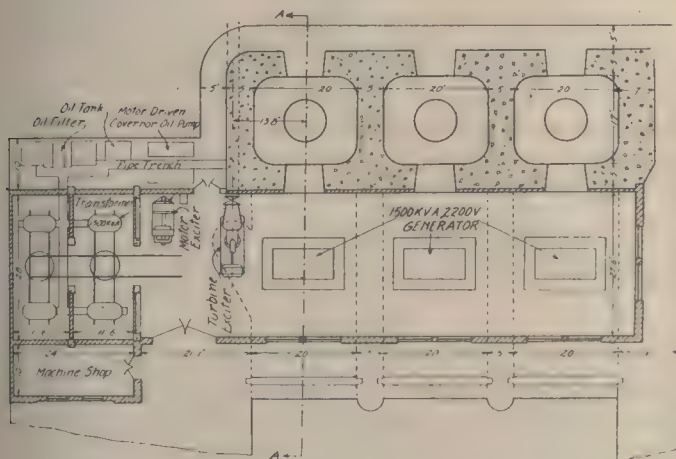


Fig. 2—Plan of power house, showing location of turbines, generators and transforming equipment

gation, recommended the construction of a new power house building and equipment to be located some 700 feet below the dam. Construction of this plant was, actually under way when the Department of Railways and Canals intimated that the Severn division of the Trent Canal was to be proceeded with and that the town had better await developments and work was, therefore, stopped.

In order to tide over this period a contract with the Simcoe Railway and Power Company was entered into for a supply of power from the Big Chute plant. A tie line was

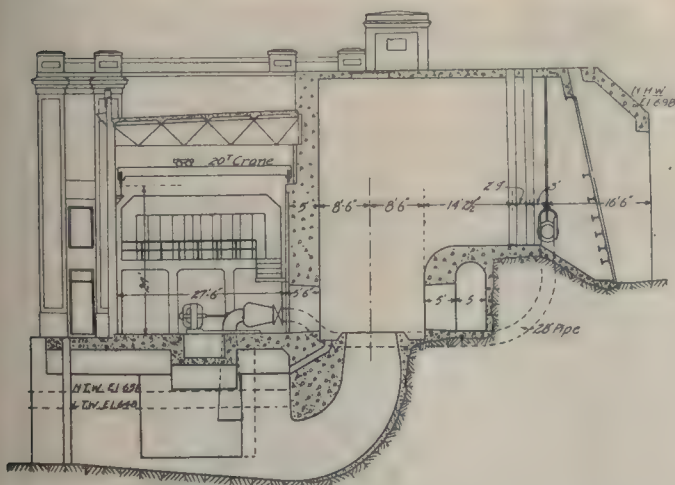


Fig. 3—Power house section—Exciter, turbine and generator shown

accordingly built from the Big Chute to the Ragged Rapids, some 9 miles in length. This line was built in a 66 foot right-of-way over very rough country, mostly granite rock ridges and swamps. The poles were 30 ft., 7 in. top cedar at 120 ft. spacing, carrying two 2-pin arms, 4 feet apart, with pin spacing of 48 inches. Three No. 2 aluminium seven strand conductors were used on Ohio Brass Company 27,000 volt, 2-piece



Fig. 4—Construction view of spillway, Swift Rapids dam

Canals to the Inland Construction Company for Section 2 of the canal work, which included the Swift Rapids dam, lock and power house, and lockmaster's house.

Fig. 1 shows the general plan of the work with the dam, penstocks, powerhouse and lock.

Fig. 2 is a general arrangement of the powerhouse, showing wheel setting, generators and transformer compartments on the main floor.

Fig. 3 shows a cross section of the powerhouse and penstocks.

Fig. 5 shows an elevation and cross section of the dam.

Owing to war conditions, the lock is still unfinished. This will be a single lock of 48 feet lift. It will be provided with one pair of mitering gates on the breast wall and a vertically operated steel gate on the lower end. This gate will be raised by operating machinery placed on a steel bridge which will be supported by reinforced concrete towers. The necessary height to give clearance to vessels means

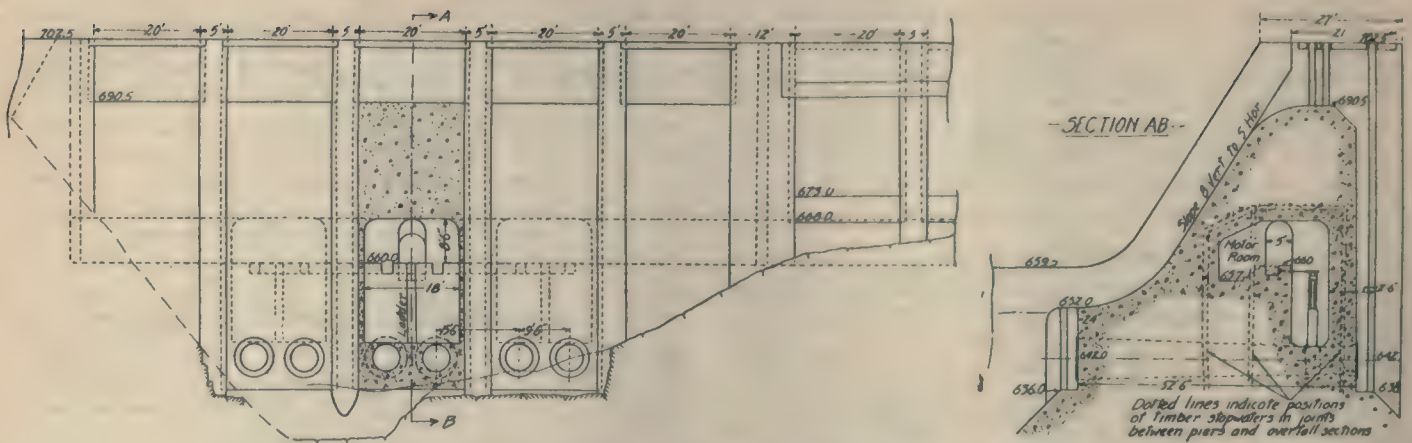


Fig. 5—Horizontal and cross section of spillway—Note Venturi sluices and inspection tunnel

that these towers will have an imposing appearance. The architectural features have not been overlooked.

Three Venturi sluices are built into the bottom of the dam, and for the purpose of unwatering them at any time stoplog checks are formed in both ends of the four piers protecting the ends of the sluices.

Small Boats Carried on Railway

To avoid locking small boats an electrically driven marine railway will be installed on the dam. It will be operated by a 20 h.p., 550 volt, 3 phase, 60 cycle motor. The estimated length of the railway track is 680 feet and it will be illuminated by 20 forty watt tungsten lamps or equivalent. The track will be carried on small concrete arches. Small boat slips will be built at each end of the railway.

Water for filling the lock will be drawn from the upper pool through a large culvert built in the rear of the south upper extension wall to valve chambers in the side walls of the lock above the upper gates, thence passing down shafts formed in the breast wall into a single culvert under the lock floor from which it will discharge into the lock through openings in the floor. The lock will be emptied through valve chambers in the culverts under the south wall in front of the lower gate, the water being drawn into the culverts through the openings in the floor.

The head of the lock will be protected by a movable

dam consisting of a small deck girder bridge and steel stop logs.

The lock chamber will be 167 feet long and 33 feet wide between the faces of the vertical side walls.

The Dam

The dam is built across the river from the upper end of the south entrance pier at the upper end of the lock to the south shore, a distance of about 230 feet. The dam is divided into two sections, viz., a supply weir at the north end consisting of three sluices each 20 feet wide and 24 feet deep for the supply of water to the power house which is below the dams and a spillway 120 feet long by 60 feet high above the solid rock in the centre of the river. The crest is divided into sluices over which a reinforced concrete platform is built. Slots in the platform are left to allow of the operation of the stoplogs on the platform.

A travelling gantry crane constructed by the Herbert Morris Crane and Hoist Company has been installed to raise or lower the stoplog controlling the entrances of the power house wheel shafts and Venturi sluices when necessary.

Water Turbines

These wheels were supplied and installed by the Boving Hydraulic and Engineering Company under contract dated July 4, 1916. The installation consists of three twin horizon-



Up-stream view of Swift Rapids dam, showing 5-section spillway on left and three turbine bay openings on the right.

tal turbines each capable of developing 2,120 b.h.p. under 45 feet head when running at 257 r.p.m. Each turbine has two runners with buckets of steel plate cast into the rim and hub, two guide cases with balanced movable vanes of cast steel bronze bushed and connected by short bronze bushed links to the regulating rings, and one draft chest of cast iron, split horizontally and vertically and provided with two man-holes.

Two features of the turbines call for comment viz., a central bearing of lignum vitae type which is adjustable from the outside by means of bronze screws, and tightening boxes for the turbine shaft which is water sealed and requires no packing material, thus doing away with the wear of the shaft. The turbine shafts are 9½ inches in diameter and consist of open hearth steel. Each turbine weighs approximately 73,000 lbs.

The turbines are regulated by three automatic oil pressure Lombard governors, which are extremely sensitive and fitted with mechanical hand regulating devices which also allow hand gate adjustment when the governor is being dis-assembled.

For exciting current purposes there is a single horizontal turbine designed to the following data: Effective head 44 feet; maximum output 150 b.h.p.; normal output 125 b.h.p.; normal speed 700 r.p.m.

Generating Machinery

The work of supplying and installing the generating plant and switchboard was carried out by the Canadian General Electric Company. There are three generators of 1,500 kv.a., 257 r.p.m., 2,300 volts, 3 phase, 60 cycles, which are directly connected to the water wheels. They are of the revolving field type. Exciting current can be provided from either of the two d.c. generators which are equal in capacity. One is directly connected to a water wheel and the other is part of a three bearing motor generator exciter set. These two generators are interchangeable in all respects. They are rated at 83 kw., 690 r.p.m., 125 volts.

The induction motor which is connected to the exciter is 125 h.p., 720 r.p.m., 2,200 volts.

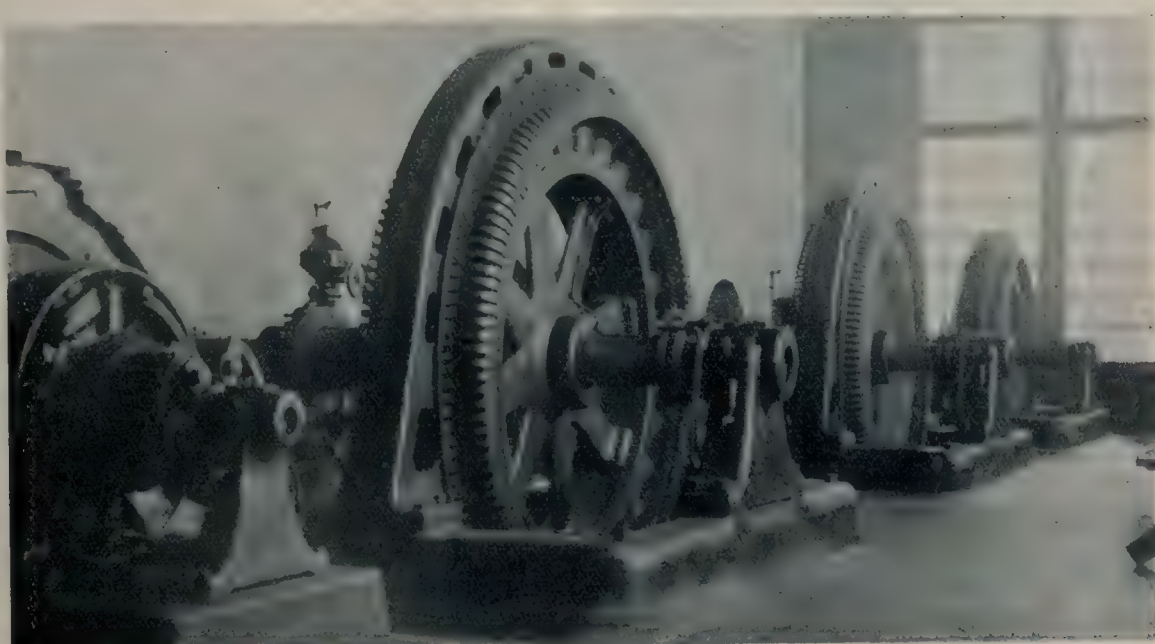
The stepping up transformers are three in number, each of 1,500 kv.a. and 3 phase. Taps on the high voltage winding allow for 25,000, 24,000 and 23,000 volts. They are water cooled core type and fitted with bell alarms and dial type thermometers. For power house and local services three 50 kv.a., 2,200 to 110-220 volt transformers are provided.

The switchboard is in a gallery above the level of the main floor and between the high tension room and transformer compartment. The panels are of natural black slate mounted on pipe supports.

The stepped-up current is conveyed through conduit from the ground floor to the third storey of the power house where the high tension bus is situated. There are three high tension lines (3 phase) proceeding from the building. Two are used for Orillia and the third as a tie line between the Swift Rapids plant and the Big Chute. One or other of the Orillia lines can be used for connection with the Wasdells Falls plant. For some time all three generating plants on the Severn River and the Eugenia Falls plant have been run in parallel, namely, Eugenia Falls, Big Chute, Wasdells Falls and Swift Rapids. The first three plants are operated by the Hydro Electric Power Commission of Ontario.

The Swift Rapids plant was first operated in November, 1917, and from that time to the date of the signing of the armistice the machines were loaded to full capacity. Owing to demands of munition manufacturers who were working night shifts there was practically no peak. Consequently, load factors ruled high and the average for 1918 was 72 per cent.

Mr. J. B. McRae, consulting engineer, of Ottawa, was responsible for the plans of the power house and plant. With him was associated his colleague, Mr. J. C. McLaren. The late Mr. W. K. Greenwood as engineer of the Orillia Water, Light and Power Commission and Mr. George Page, power house superintendent, were also intimately in touch with the work during both its inception and construction. For the information contained in this article we are indebted, in part, to the late Mr. Greenwood, and in part to Mr. F. Gover, secretary Orillia Water, Light and Power Commission.



Electric generating equipment in Swift Rapids plant—Three 1500 kv.a. units

Canada Has Important Marble Resources

Bancroft Marble Areas in Hastings County, Ontario, Contain Immeasurable Deposits of Marble Comparable to Any Foreign Product

By W. H. Matthews*

THE term "marble" is often applied, in a general way, to any kind of limestone capable of receiving a polish. More correctly, it is used to designate a fine-grain aggregate of calcite crystals produced from ordinary limestone by the action of heat and pressure. (See report on Building and Ornamental Stones of Canada, by Dr. Parks, Department of Mines, Ottawa). When commercially pure it is snow-white and known as statuary marble, and is used for the purpose that its name implies. The presence of chemical impurities and their conversion into new minerals by the process of metamorphism, gives rise to the great varieties of coloring found in various marbles ranging from faint grey and cream monotonous, through light pinks, blues, yellows, greens and browns, to the deepest reds, purples and blacks.

Ancient Marbles

The value of marble as a building stone has been recognized from the earliest times. Its durability, its structural strength and its beauty of texture and coloring led to its selection by the architects of Greece and Rome, as the medium in which to express in permanent form their noblest conceptions of the majestic and beautiful, and the wisdom of their choice stands justified to-day in the mighty ruins of the Acropolis, the Parthenon, the Forum, the Coliseum and many others. The greatest of Roman emperors could find no prouder title to fame than that he found Rome a city of brick and left it a city of marble. It was, of course, the accessibility and the practically inexhaustible extent of the deposits of fine marble at such famous quarries as those of Pharos and Pentelicon in Greece and Carrara in Italy, that made its free employment possible in the building of the cities of the ancients. Architects in other lands and in more modern times have not been so fortunately placed. While marble is found generally throughout the earth's surface it seldom occurs in deposits which combine the three commercial essentials of fine quality, economic working, and proximity to the markets.

American Marbles

In the United States the marble areas possessing these requisites to the largest degree are found in Vermont, Tennessee and Georgia, and in each case a large and valuable industry has developed. The importance and value of the industry have been realized, not merely in the form of large returns for the money invested in the various quarry undertakings, but distinct gain to the nation has also resulted in rendering possible the employment of a large number of men, and in making possible the production of marble for exterior use as well as for interior embellishment in many of the more important public buildings erected within the last few years. Those marbles, however, while of good quality, and particularly in the case of Vermont and Tennessee in immense quantity and easily worked, are lacking in the very important matter of range and variety of coloring. Very few

decorative or finely colored marbles of commercial exploitation are found in the United States, and increasing demand and requirements for marbles of this kind are met by the importation of expensive Italian and other foreign varieties. The value of marble quarried in the United States is given by the department of Commerce, as follows: 1910, \$5,477,304; 1913, \$7,546,718.

Marble Deposits of Hastings County

It is in keeping with the revelation of Canada's natural wealth in so many different directions that it should have been recently discovered that Canada possesses in the county of Hastings, Ontario, what must be regarded as the most important marble deposit on the North American continent. A reference to "The Geology of the Haliburton and Bancroft Areas" by Dr. Adams and Dr. Barlow, and to Dr. Park's report on the "Ornamental Building Stones of Canada," reveals quite clearly why this should be the case. What is known to the geologists as the Grenville series of limestones traverse the county of Hastings and reach there the immense depth of over 50,000 feet, the thickest development of pre-Cambrian limestone in North America.

Marble, as has been already stated, is formed from ordinary limestone by the action of heat and pressure. To both of these actions the limestones of the Grenville series were subjected in the severest form, with the result that within the defined area in the county of Hastings are found marble deposits of the finest quality and of practically immeasurable extent.

After careful examination and selection during the past eight years by experts and engineers, the Canadian Marble Quarries, Limited, have acquired what are considered the most valuable marble properties in America. During this period of time, constant work has been carried on to prove the marbles at depth by digging trenches, uncovering the marble, core drilling and putting down test holes. The cores taken from a depth of 198 feet show in every case a maximum of freedom from fissures, cracks and impurities. The formations are sound as possible and, in some cases the drill went forty feet without encountering a single break. Marble is apparent close to the surface over practically the entire area of these properties and attention is called to the reports of our Government experts, Dr. Barlow, Dr. Parks, and many other eminent scientists that have studied this deposit, and who have stated that the depth of the strata is many thousands of feet. As it is only practicable, however, to quarry to, say, 500 feet, estimates should not be based on more than that.

On one property cores have been taken over an area measuring 800 feet long by 200 feet wide to an average depth of 100 feet, which proves a mass of 16,000,000 cubic feet of solid marble. Similar but not so extensive drillings, have been made at different places on the properties, thus proving many millions of cubic feet more. These areas drilled represent only a small portion of the entire acreage, so that it may be stated that the location possess an inexhaustible

* Of Canadian Marble Co., Limited, Toronto.

supply of marble. In making the drillings care was taken to prove large quantities of particular kinds of marble, so that a definite statement could be made in reference to the possible requirements of any particular kind.

Comparable to Foreign Marbles

Operations to date have disclosed a wide variety of marbles, some of which are highly decorative and compare very favorably with the finest imported Italian marbles used in this country. They are rich in quality, fine in grain, remarkably free from impurities and cracks; in fact, there is not one single piece in the collection of specimens which requires the use of a filler of any sort to make it presentable, as do many of the finest foreign marbles. This is in spite of the fact that these samples were taken from the surface.

These specimens have been examined and highly approved of by some of the most prominent architects, contractors, and quarry men in America. It is anticipated that a large business in these high-priced decorative marbles can be done in the United States, which depends mainly at the present time upon Europe for marbles of this class. Of even more importance than the decorative marbles are the various monotones or plain colored marbles, ranging from blue-white, similar to Carrara marble, to buffs, pinks, blues, light greens and browns. Some of these are especially suited for exterior building work, and some for interior work of an ordinary commercial character, such as wainscoting, flooring, counters, lavatories, etc., which at the present time form the bulk of the marble business of the country.

It has been predicted that Canada will be, in the very near future, one of the most prominent producers of marbles in the world, on account of the fact that the quarries, being ideally located in close proximity to railroads and water power, will have such an advantage in the matter of economic working and development that the output may be sold in competition with foreign marbles.

Montreal Warehouse and Office

Williams & Wilson Building—Four-Storey Concrete Beam and Slab Design

ONE of the recent concrete structures erected in Montreal, is the warehouse and office building for Messrs. Williams & Wilson, Limited, machinery supply dealers. This building has a frontage of 44 feet on Inspector St., running through to Montfort Street in the rear, a distance of 188 ft., and comprises four storeys and basement. The structure consists of a reinforced concrete frame of beam and slab construction with brick curtain walls. The Inspector Street facade is built up of Indiana limestone pilasters bonded to the concrete frame and worked up in three bays. The centre bay is 25 feet wide to provide a large "show" window on the ground floor to allow an unobstructed view of the contents. Between pilasters the entire front is built up of architectural ironwork and glass to the ceiling of the top floor, over which the limestone is arched to give the pleasing appearance shown in the illustration.

The ground floor is 4 feet above the level of In-

spector Street, and the "show" window floor is supported on a concrete beam at the street level.

The main entrance door is of oak with an ornamental iron grill to protect the glass, and brass kick-plates. Two ornamental lighting fixtures are mounted on the outside walls at the entrance. The entrance porch is panelled with marble, the panels, capping and base of Venosa marble and the styles of light vein, and the steps with Venosa marble treads and risers.

Cantilever Footings

One of the engineering difficulties to be overcome on this building was caused by the necessity of placing the column footings on sand, in which was a heavy flow of ground water, as the basement floor is several feet below sewer level. The wall footings also were not extended beyond the property line. To meet with these requirements the footings were designed as



The Williams & Wilson building, Montreal.

cantilevers, of heavy reinforced concrete. The basement floor, which is made 12 in. thick, to prevent uplift, and walls are waterproofed with "Tockolith" put in the mix, to prevent the entrance of ground water.

The floor slabs are designed for heavy loading, as follows: ground floor, 300 lbs.; first floor, 100 lbs.; upper two floors, 250 lbs.

Shipping Facilities

Excellent shipping facilities have been arranged into Montfort Street, where the ground floor frontage is entirely taken up by two large shipping doors, which, besides the ordinary wooden doors, are equipped with steel roller fire curtains. From Montfort street the trucking floor runs 35 feet into the building at street level, then 3 feet above is the shipping floor proper, which allows the goods to be trucked direct on to motor trucks, which are backed into the building so as not to obstruct the traffic on Montfort Street. A

complete equipment of 'Bowser' gasoline and oil pumps are installed in the shipping room.

Office

The entire second storey is used as an office. The floor is laid in marble squares, in which are inserted flush boxes for individual telephone service at each desk, doing away with unsightly open telephone wires. The walls are panelled in selected white maple. The lighting for this floor is accomplished by specially designed lighting fixtures. The third floor is laid in cement, with a special hardener cement finish, treated with two coats of cement dressing. The top floor is equipped as a machine and wood-working shop. The shafting hangers are carried on inserts set in the concrete beams.

The Montfort street elevation is laid up in red brick with exposed concrete beams and lintels. All windows have steel sash, wire glazed. The ordinary type of iron fire-escape, with scuttle ladders, is mounted on this elevation. The interior stairs from floor to floor are of steel, with slate treads, and all enclosed

in fireproof steel and wire glass enclosures. Each floor is equipped with lavatories of the latest type. Two 'Leonard' boilers provide the necessary heating, which is the Webster vacuum system. On account of the length of this building it was necessary to provide a light well, 53 feet long, on the north side, to let daylight into the centre of the building.

A 5-ton, direct-connected elevator, with 8' x 12' platform, is installed to handle heavy machinery and is equipped, at each floor, with 'Peelle' interlocking fire-doors. Provision is made for the installation of a light elevator.

The building was designed and erected under the supervision of T. Pringle & Son, Limited, engineers and architects, of Montreal and Toronto.

The general contract was carried out by E. G. M. Cape & Company, Limited, with the following sub-contractors: Lighting, Montreal Electric Company; heating, W. G. Edge, Limited; iron work, John Watson & Son (Montreal) Limited; boilers, Leonard & Sons; elevator, Otis-Fensom Elevator Co., Limited.

Cost Keeping for Highway Contractors

Methods of Determining Unit Costs—Obtaining Overhead Costs
And Properly Prorating Them—Importance of Daily Costs

By H. P. Gillette

ALTHOUGH several books and a great number of articles on cost keeping have been published during the last ten or twelve years, there still exist many contractors who, apparently, agree with the old time contractor who said: "The only cost keeping that I need is what my banker does for me. If his records show that I have a larger bank balance after the final payment on a contract than when I started it, then I am satisfied with my men, my methods and my luck. But if my bank balance is smaller at the end of the job, to h— with my luck, my methods and my men."

No Hair-Splitting Methods

This is the attitude of many a practical man, but to all such a word of advice may prove helpful. While luck cannot be changed by having a suitable system of cost keeping, it often happens that such a system leads to a change both in methods of doing work and in the foremen and superintendents in charge of it. Indeed the leading object in keeping unit costs is to find out the least costly way of doing a given kind of work and the most efficient bosses. Since this is the main object, it follows that an effective cost-keeping system must show the unit costs at the end of every week, and if practicable, at the end of every day. But to accomplish this purpose it is usually necessary to cut out all hair-splitting, such as most accountants and book-keepers indulge in. Rough and ready methods of estimating the number of units of work must frequently be adopted; approximate estimates of overhead costs must nearly always be used; and, in short, the aim must be to get at the unit costs within a few per cent., say 5 per cent., rather than "to the last red cent." It is that "last red cent" ideal of the book-keeper that is accountable for the practical failure of many a cost keeping system.

As an illustration, take almost any dirt digging job

and try to apply the usual book-keeping methods to it. The time-keeper may report each day the day's labor cost of excavating, but he does not ordinarily ascertain the yardage of earth moved that day. Perhaps the engineer can give a rough estimate of the yardage, but his estimate may be 25 per cent. off, for he usually makes his guess merely by looking at the partly graded roadbed. Since the engineer seldom makes a careful quantity estimate oftener than once a month—and it is not always careful then—it follows that there are very few grading contracts on which the cost per cubic yard of earth excavated is known within 10 or 15 per cent. at the end of each week. As for knowing the earth yardage cost for each day, how many have ever seen a contractor who did know it?

Estimating Excavation Yardage Daily

For a long time the author regarded it as impracticable to estimate earth yardage costs with reasonable accuracy oftener than at the end of each week. Several years ago the author's brother, W. A. Gillette, devised a method of estimating earth yardage on grading jobs every day. The method consists in mounting a time-keeper on a horse and having him ride from gang to gang all day long, stopping 20 to 30 minutes at each gang. If a gang is excavating with fresno scrapers, for example, the time-keeper counts the number of fresno loads taken out by the gang in, say, 20 minutes; and he records the count for that gang. Then he rides on to the next gang, which, let us say, is loading earth by hand into wagons. This gang is timed for, say, 30 minutes, and the wagon loads are counted.

In the course of the day each gang is thus visited and its output counted several times. If, for example, gang No. 1 has been visited three times and during a total time of one hour it has turned out 50 fresno

loads, it is then estimated that it would turn out 400 loads in eight hours. An estimate is made of the average size of a load, and the total yardage output of gang No. 1 for that day is estimated. Similarly with the other grading gangs. At the end of the month the totals thus estimated are compared with a careful monthly estimate based on cross-sections. After a little experience it is possible thus to estimate within 5 per cent. of the actual yardage moved.

Of course this intermittent count method cannot be expected to give satisfactory results unless good judgment is used in its application. But it has been shown to the author's satisfaction that the method is sufficiently reliable when properly supervised. That it is simple is self-evident.

Obstacles to be Overcome

The two greatest obstacles to the successful use of any cost keeping system are, first, a fairly accurate measurement of the number of payment units of work done each day, and second, a correct ascertainment of the total time lost or wasted by each gang. By "payment units" is meant the units of work for which a contract price is paid, as, the cubic yard of earth excavation, the square yard of pavement, etc.

All costs should be finally reduced to so and so many cents or dollars per payment unit, so that the contractor can compare them with his contract prices. Fortunately the highway contractor has a relatively simple task in devising methods of measuring most of the payment units every day. Excavation measurements are the most difficult to secure daily, but a suggestion as to how this may be done has just been given. The yardage of pavement laid daily is readily ascertained. Since excavation and paving usually constitute the bulk of the cost of a road, it is evident that if a contractor can keep these two items of cost within his bid prices, he can usually "win out" on the entire job.

Recording Lost Time Daily

Lost time is the bottomless pit into which more money has been dumped by road contractors than can be estimated. The author has seen, and has himself experienced the bitterest disappointment resulting from time lost while wages were going on. It is not an uncommon thing to lay twice as much yardage of concrete on a day entirely free from delays as is laid on the average day. In other words, it seems practicable to do twice as much work daily as actually is averaged. How is this ideal to be attained, or at least approximated? Only by system, and system involves keeping costs in such a manner as to locate definitely and immediately each period of lost time for each gang, and the reason why.

Does the crusher shut down for an hour for repairs? Then the time report for the quarry must show the time of stopping and the time for starting, and the reason for the shutdown. It should be the time-keeper's duty at the end of each week and of each month to summarize all the time losses in the quarry, so that the contractor or his superintendent can see at a glance the size of this loss. Perhaps no better way than this can be invented to demonstrate what extra parts should be kept on hand to minimize delays. Here it may be suggested that whenever a new machine is purchased, the manufacturer should be asked to recommend what and how many spare parts should be carried in stock by the purchaser.

Where the cost of lost time, due to breakdowns,

is kept, it frequently becomes evident that it is economic not merely to have spare parts on hand, but to have entire spare machines. Take a pump, for example, that is delivering water to a concrete mixer and for sprinkling, etc. Upon the service of that one pump will depend the progress of the pavement. Yet to save an investment of \$500 to \$1,000 in a spare pump, many a road contractor loses several fold that sum each year. Such losses result from failure to keep records that show the cost of lost time.

Daily Overhead Costs

Closely associated with the question of lost time is the question of overhead costs. Among "overheads" should be included superintendence, office expense, interest and depreciation on plant. Superintendence should include some compensation for the contractor's own time. To the author it seems desirable to divide the contractor's compensation into two parts, (1) salary, and (2) profit. The salary should be only as large as would be paid to a skilled superintendent. The profit should cover both compensation for the contractor's skill as an organizer and financier, plus insurance against all risks for which an insurance policy cannot be secured.

A common mistake in estimating "overheads" consists in dividing the annual overhead cost by the number of working days in a year, instead of dividing by the average number of days actually worked. In our northern climates the number of days actually worked by a given organization on road construction usually averages about 125, but there are 300 working days in a year; hence a highway contractor and his plant are usually idle nearly 60 per cent. of the working days of the year. If a contractor's annual salary as a superintendent be added to the annual salaries of his permanent employees, and if this salary total be divided by 125, instead of by 300, the salary "overheads" per day worked will be ascertained for all practical purposes. Similarly as to plant "overheads" and office rental "overheads."

The total "overheads" per day actually worked must be apportioned among the units of work done. Both highway contractors and engineers who have not been accustomed to prorate overhead costs in this manner will get some surprises. Failure to do this is largely accountable for the fact that so many road contractors "go broke," and it also throws light upon the fact that a good many engineers think that road construction can be done more cheaply by day labor than by contract.

Prorating Overhead Costs

Having estimated the overhead costs per "day worked" (not per working day), some of these daily overheads can be assigned directly to a given class of work. Thus, the daily interest, depreciation, and repairs on a concrete mixer can be assigned to the pavement. But certain of the daily overhead costs must be prorated to the different classes of work. There are several theories of prorating joint costs which the author has discussed at some length in the Handbook of Mechanical and Electrical Cost Data. Usually it suffices on construction work to prorate overhead salary costs in proportion to direct labor costs. Thus, if the direct labor cost of grading is \$50 a day and the direct labor cost of paving is \$100 a day, and there are no other direct labor costs, then one-third of the daily cost of general superintendence and office expense is assigned to grading, and two-

thirds to paving. Having assigned all the daily overheads to the different classes of work, divide each assigned total by the number of units of work performed each day worked, to get the unit cost of overheads for each day. It should be noted that by using this method there are no overhead costs for the days on which no work is done, for all the overhead costs are assigned to the days actually worked each year on the average. While there are some objections to this method, it is the only method by which the total unit cost can be estimated with any degree of accuracy for each day worked. And it is highly important to have such an estimate in order to know whether a profit is being made or not. The average road contractor who has a unit cost keeping system usually is deceived into thinking he is making money, because the daily overheads are either not known or are not properly allocated to the various classes of work.

Cost of Installing and Shifting Plant

There is another source of error in estimating daily or weekly or monthly profits which arises from failure to segregate the cost of installing, shifting and removing the various plant units, together with miscellaneous costs of getting ready to do work. It is rare that any contractor is able to state what these "preparatory costs" have been on any given job, and this holds true even where the contractor has a cost keeping system. No argument is needed to prove that unless the "preparatory costs" are known there is grave danger of under-estimating the total unit costs.

Having so kept the daily records as to show the actual cost of moving and installing a crushing plant, for example, to this should be added the estimated cost of shifting it (where shifting will be necessary) and the cost of dismantling and shipping it home. Then this total should be divided by the total number of cubic yards of stone to be crushed on the given job, to get "the unit preparatory and shifting cost" of crushed stone. This unit cost should be added each day to the "unit overhead cost" and the "unit direct cost" for that day. The resulting total will then, be really significant as to what the pavement is actually costing.

Importance of Daily Unit Costs

It will be noted that the author is contending for the daily and weekly estimating of the total unit cost of each class of units upon which there is a contract price. Unless this is done it almost invariably happens that the road contractor who thinks he has been making a profit on a job awakens toward its close to find that he has actually lost money on it. Now he may lose money on the job even if he does have complete unit costs before him every day, for it is very common to bid so low a price that no profit can possibly be made. But it is surprising what a difference there is in the energy of a desperate man as contrasted with one who is well satisfied. When a contractor realizes that he is daily sinking deeper into the quicksands of bankruptcy, he will usually "camp on his job" night and day, and his wits will be steadily at work, whereas if he thinks he is making a satisfactory profit, he is apt to take things easy, let well enough alone, go off on frequent pleasure excursions and the like.

Summing up, a road contractor can use his brains to no better advantage than in finding ways of securing daily reports that show the total unit cost of every item on which he has bid a unit price. To do this it is frequently necessary to invent methods of securing

approximately correct estimates of the number of units of work done, and it often pays to employ an engineer for no other purpose than to measure up daily the number of units. Lost time should be reported daily and its cost estimated. Overhead costs should be estimated per average day worked, not per working day, and unit overhead costs estimated every day. Plant, preparatory and shifting costs should be kept apportioned to each class of work, and reduced to unit costs.

If these methods are adopted, profits will be increased or losses decreased. If engineers in charge of contract work will follow the same method, they will usually discover that there is little or no profit to the average road contractor. Indeed unless engineers give adequate study to the costs of lost time, overheads, plant installations, etc., and unless they devise ways of enabling competent contractors to secure adequate prices, it will be only a matter of a few years before there will be no competent contractors in the road building business.

The above paper was presented by the author at the recent convention of the American Road Builders' Association.

Proposal for Memorial Municipal Buildings at Ottawa

An extensive scheme to perpetuate the memory of the Ottawa soldiers who have fallen in battle is proposed by the Ottawa Memorial Hall Association. At a recent meeting a report submitted by a special committee, headed by Mr. Thomas Adams, was adopted by the Association. It suggests that a group of municipal buildings be erected on the site of the present City Hall and other municipal buildings. The memorial hall would be distinct from the new city buildings, but would form part of the group. The expenditure required might be from \$1,000,000 to \$1,500,000. The site recommended is believed, after a consideration of the governing features of such a scheme, to be the most suitable in the city. On it there is room for a municipal building, memorial hall, and for new police offices, land registry, and any other municipal or semi-municipal offices. If ample space is preserved around the buildings, and their architecture is of a suitable type, there need be practically no limit as to the height of any part of the group.

"To the east of this site, owned by the city," the report states, "there is an area of land which we understand is held under lease from the Dominion government. This land should be gradually cleaned up and converted into a park when the present lease is expired forming a continuous parkway between Connaught Square and Laurier Ave. bridge.

"If necessary, the present City Hall might be left as it is for a time and the Memorial Hall erected at its rear until money is available to complete the scheme."

The report recommends that, after obtaining the approval of the federal and municipal authorities, the Association, acting in concert with the City Council, should obtain expert advice with regard to the layout of the site and the disposition of the proposed buildings and further with regard to the desirability of acquiring additional land and should then call for competitive architectural designs. Also it is suggested that a campaign be undertaken to raise funds as might be necessary by private subscription.

The above scheme is entirely separate from the proposed federal memorial project.

Standardization of Plans for Schools

How Uniform Practice in Preparation of Designs Has Reduced Office Work and Produced Economies in Cost Without Sacrificing Architecture

By Clarence E. Dobbin

THE term "plan production" may be objected to by some as resembling too closely the term "shop production" used almost exclusively by manufacturers; but the fact remains that there is a distinct problem of this kind in any architectural office with a volume of work such as we have in hand. It is a problem of sufficient importance to merit thoughtful, scientific treatment and if it is handled without sacrifice either in architectural design, planning or construction there can be no valid objection to any appropriate term used to designate it.

In order to obtain uniform practice for all jobs in course of preparation at any one time, we have reduced to writing all instructions and decisions that go to make up our office practice. These, together with tabulations, small drawings showing typical arrangements of the various standard rooms, and other details that may be of assistance to draftsmen, are bound in loose-leaf form with subjects alphabetically arranged and make up what is termed our Office Manual. A copy of this is placed in the hands of each squad leader for ready reference.

Standard Instructions

Each new question that arises is investigated and considered with great care and when a satisfactory solution is reached the necessary instructions are placed in the manual. If later on a better solution is evolved, new instructions are issued to replace the earlier ones. The manual keeps everyone informed as to the latest decisions so that all effort may be directed towards the same objectives. The squad leaders are expected to see that their assistants follow these standards, or, if a variation seems advisable, to refer the matter to the chief for decision.

In this way only can the practice of the office be kept standard. In the absence of such a manual the office practice must be transmitted from one draftsman to another by word of mouth. This is the usual method and it is responsible for great loss of efficiency, because the same questions are asked and answered repeatedly, and the same problem solved again and again, with attendant discussions, delays and variations in practice. New men have no definite, accurate way of acquiring the office practice and often proceed along incorrect lines.

The planning of our new school buildings is accomplished through the co-operation of the four divisions into which the office is divided—General Drafting and Plumbing, Heating and Ventilation, Electrical and Furniture. Each of these divisions has its own head and all are under the immediate direction of the Architect in Chief, who also has jurisdiction over the inspection force connected with the construction and equipment of the buildings.

Standardization Facilitates Design

In our steel designing many of the factors are constant. The dead weight of our typical floor construction is always the same and the live loads for certain groups of rooms are alike. We have therefore developed tabulations of various kinds that enable the en-

gineers to select the steel shapes much more quickly than by computation or by reference to a hand book. One such table gives the safe I-beams for different lengths and spans, assuming our typical dead load and a live load of 75 lb. There are other tables for live loads of 100 lb., 120 lb., etc. Having worked out a beam plan and fixed the lengths and spans of the beams, their sizes can be obtained from these tables with the least expenditure of time. Similar tables have been provided for many other structural members for which we have constant use: channel columns for our standard story height of 15 ft. 0 in., safe loads for struts made up of one, two and four angles in various positions, etc.

The volume of work is such that a number of jobs must be put forward at the same time. The work naturally segregates itself into subdivisions, such as general planning, designing, scale detailing, full-size detailing, structural-steel and other engineering, plumbing, specification writing and computing.

The first essential is a properly organized and balanced drafting force. The employees of this division are divided into appropriate squads, each of which is continuously engaged in one kind of work. While the personnel of the squads may change from time to time the leaders at least are comparatively permanent and become thoroughly familiar with the established methods in their particular branches of the work. The qualifications, inclinations and aptitude of each man are studied so that he may be placed where he will count for the most. This is a matter of great importance and careful attention to it has led to the discovery of special ability in some men, which when developed has produced surprisingly good results.

Special Details Reduced to a Minimum

The next step is to standardize the details for features which occur repeatedly in different buildings; for example, a standard detail is made covering the entire construction of the ordinary double-hung window. This drawing is made on tracing cloth and once prepared can be used for any number of buildings without further drafting, by striking off the necessary number of blue prints. Similar standard details are made for pivoted windows, hollow metal windows, steel windows, steel doors, wood doors, kalamein doors, skylight construction, vault-light construction, interior trim, cabinets, wardrobes, lockers—in fact, for every possible feature of the building from column bases to the flagpole on the roof. These standard details do not entirely obviate the necessity for special details, but their number is thereby reduced to the minimum.

The advantages of these standards are threefold: First, the entire subject is very thoroughly studied when the standard is prepared and the detail is made to cover every phase of the construction, so as to furnish all the information required on that subject. Second, the draftsmen become familiar with the standards and are able to proceed with the plans much more expeditiously. Third, the contractors after be-

coming familiar with them, are able to systematize their methods of production and to reduce their estimates accordingly.

This division has at the present time about 100 standard details of this kind. A complete file of these is furnished to each squad leader and each is required to plan his work in conformity with them as far as practicable. This does not discourage suggestions on the part of assistants. These are always welcomed and the standards are revised whenever better methods are found. It does prevent waste of time in study of unauthorized variations of no practical value, undertaken often for no better reason than the desire to do the thing differently.

When conditions are such that a type building cannot be used, the general plans, framing plans and plumbing plans must all be specially made; but the standard details are applicable to these as well as to the type buildings, which minimizes the labor of detailing.

Reducing Amount of Tracing.

Where the drawings for one building are to be substantially like those for another building we take advantage of methods of process reproduction in order to reduce the amount of tracing. It is necessary to have a full set of tracings for each building, because additional prints may be needed at any time, either during the progress of building or after completion.

An earlier attempt to curtail drafting by making prints for all similar buildings from one set of tracings and then applying pasters covering the variations, had to be abandoned owing to the difficulty of keeping the great number of paster tracings, and of assembling sets of prints made up of the original sheets with innumerable pasters. There was also too great a liability to error.

Where the ornamental features of buildings of the same type are alike, the details for these are made in standard form, so that having once prepared tracings of these details for the first building they apply without change to any extent desired.

If all buildings could be made to conform to one or another of the standard types, plans could be produced with great rapidity, but unfortunately this is impossible. The present building schedule comprises five new buildings of Type A, one of Type B, two of Type C, three of Type E, six of no standard type, and seven additions. This schedule of 24 items, made up prior to the adoption of the type buildings, offers only seven opportunities for duplication. In future building schedules it is expected that greater use will be made of the standard types.

Buildings requiring additions are usually old, badly planned and in many cases do not lend themselves to extension. The amount of time and study required for a comparatively small addition may easily equal or exceed that for a new building of much larger size. In the present building schedule, therefore, the advantage gained by the opportunity to duplicate seven buildings is largely counterbalanced by the seven additions.

Number of Extras Reduced

Before plans are given out for bidding they are made complete in every detail, so that there is no room for misunderstanding as to the extent or character of the work to be performed. The drawings for a Type A building comprise the following:

General plans 17 drawings

Steel plans	9 drawings
Plumbing plans	10 drawings
Special details	29 drawings
Standard details	78 drawings
—	
Total	143 drawings

All of these are completed and available to the contractors for estimating and all are issued to the successful bidder as soon as his contract has been approved, which enables him to proceed with his work without delay.

This practice insures complete checking, cross-checking and correction of drawings before any of them are given out. It also tends to lessen the number of extras on the contracts, due to omissions or errors. In proof of this it may be stated that in eight years' work, the contracts for which amounted to \$28,000,000, extras of this kind amounted to only \$24,000, or less than 0.1 per cent. When it is realized that the extras on one building frequently equal that amount, the advantage of complete, accurate drawings and specifications becomes apparent.

The adoption of the standard specification with amendments has resulted in a great saving in the labor and expense of writing, editing and printing the specifications. No time or thought has to be devoted to the standard specifications, which comprise about 80 per cent of the whole. It is only necessary to take care of the variations from the standards, or about 20 per cent.

Unwieldy Drawings Unnecessary

By the exercise of determination and against the judgment of some of the men, it has been found not only possible, but advantageous, to limit the size of drawings to dimensions that are practical for drafting as well as for use on the building. It is no longer necessary for our draftsmen to recline full length on their work nor to wear carpet slippers so that they may walk on it. Neither is it necessary for the contractor to cut his drawings into sections before attempting to use them. Tracing cloth is purchased in sheets of standard size with a margin line and the department and signature stamp printed on each sheet. The printing is less expensive than lining, lettering and stamping by hand.

Payments on the contracts are made on the basis of 90 per cent of the amount earned at various fixed stages of the operation. The work included in these various payments, together with the percentage of the contract price to be paid, is printed in the specification. This method as distinguished from the usual monthly payments, has been found highly satisfactory, because it eliminates all controversy as to the amounts earned and all opportunity for contractors to obtain excessive payments as a preliminary to abandonment of the contract. In order to fix the percentages for the various payments, an accurate quantity estimate is made and this is segregated into the payments determined upon.

The above article was read by the author before the Municipal Engineers of the City of New York.

The city of Montreal has only \$21,800 available for street improvements. There is a sum of \$10,992,406 available on loan account, but of this \$4,172,536 has been set aside for the construction of underground conduits, and \$4,830,016 for enlarging the aqueduct, and for the filtration and lighting plants.

Canadian Roads Congress

Tentative Programme for Convention to be Held in Quebec in May—Exhibition in Conjunction with Congress

MAY 20, 21 and 22 are the dates set for the Sixth Canadian Good Roads Congress and Exhibition to be held in the Parliament Buildings, Quebec City, under the auspices of the Canadian Good Roads Association. The tentative official programme is given below. In a letter addressed to the manufacturers and representatives of road materials, machineries, etc., the officers of the Association draw attention to the efforts being put forth to make this a most successful convention and to carry on their educational campaign is an unprecedented measure. A new chapter in the history of road-building in Canada is presented, it is said, since our federal government has taken up the question of aiding the provinces in the matter of road construction and since the Association has by its Dominion-wide charter obtained the collaboration of the provinces themselves in the matter of its educational campaign, in addition to which facts the cessation of hostilities must not be overlooked.

In conjunction with the congress, an exhibition comprising light exhibits, such as samples of road materials, photographs and models of road machinery, etc., will be held.

The tentative programme is herewith submitted:

TUESDAY, MARCH 20th

Registration of delegates and visitors at Parliament Building. Registration continuing throughout the Congress.

Appointment of Nomination, Resolution and Legislation Committees.

Morning Session

Congress called to order by the President, Mr. S. L. Squire.

Address: Hon. Sir Charles Fitzpatrick, Lieutenant-Governor; Province of Quebec.

Address: Hon. Alfred E. Smith, Governor State of New York, Albany, N. Y.

Address: Hon. Harris F. Graham, Governor State of Vermont, Montpelier, Vt.

Address: Hon. Carl E. Milliken, Governor State of Maine, Augusta, Me.

Address: Hon. Calvin, College Governor, State of Massachusetts.

Address: Sir Lomer Gouin, Prime Minister, Province of Quebec.

Address: Sir William Hearst, Prime Minister, Province of Ontario.

Address: Hon. J. D. Reid, Minister of Railways, Canals and Highways, Dominion Government, Ottawa.

Address: Hon. W. G. Mitchell, Treasurer, Province of Quebec.

Address: Hon. A. Veniot, Minister of Public Works, Province of New Brunswick.

Address: Hon. Finlay MacDiarmid, Minister of Highways, Province of Ontario.

Address: Hon. J. A. Tessier, Minister of Roads, Province of Quebec.

Address of Welcome, Mayor Lavigueur, City of Quebec.

Address of Welcome, O. W. Bedard, President, Quebec Board of Trade.

Address of Welcome, Mayor Noel Belleau, City of Levis.

Address of Welcome on behalf of Canadian Good Roads Association, Capt. J. A. Duchastel de Montrouge.

Address of Welcome, L. B. Howland, President, Canadian Automobile Association.

Address of Welcome, Hon. Frank Carrel, President Quebec Automobile Club.

Address of Welcome, A. L. Caron, President, Quebec Provincial Motor League.

Afternoon Session

Address: "Federal Aid," by Hon. J. D. Reid, Minister of Highways, Railways and Canals, Ottawa.

"Highway Maintenance," by Capt. J. A. Duchastel de Montrouge, C.E., Manager City of Outremont, P. Q. Discussion by Gabriel Henry, C.E., Chief Engineer, Province of Quebec.

"Gravel Roads," by Chas. Talbot, C.E., County Road Superintendent, London, Ont.

"Surface and Subsoil Drainage and Foundations," by Gabriel Henry, C.E., Chief Engineer, Province of Quebec Highways Department.

Annual dinner and entertainment at Chateau Frontenac in the evening.

WEDNESDAY, MAY 21st

Morning Session

"Roads as an Aid to Agriculture." Address by Hon. Geo. S. Henry, Minister of Agriculture, Province of Ontario and Hon. J. A. Caron, Minister of Agriculture, Province of Quebec.

"Hot Mix Asphalt Pavements," by Francis P. Smith, Ph. B., Consulting Engineer, New York City. Discussion by E. Drinkwater, Consulting Engineer, St. Lambert, P.Q.

"Practical Advice to Road Superintendents and Municipal Councils," by Alexandre Fraser, C.E., Assistant Chief Engineer, Province of Quebec, Highways Department.

"Bituminous Macadam," (Penetration Method) by A. W. Dean, Chief Engineer, Massachusetts Highway Commission. Discussion by E. A. James, Chief Engineer, York County, Highway Commission Toronto.

Annual Meeting, Canadian Automobile Association, at Chateau Frontenac.

Afternoon Session

"Shall We Restrict the Load or Build the Road," by W. A. McLean, Deputy Minister of Highways, Province of Ontario.

"Concrete in Road Construction, Culverts and Bridges," by Eltinge G. Breed, Chief Engineer, New York State Highways Department, Albany, N. Y.

"Construction and Maintenance of Macadamized Gravel Roads," by Alex Lariviere, C.E., Engineer, Province of Quebec, Highways Department.

"The Use of Refined Tar in Construction and Maintenance," by Paul D. Sargent, Chief Engineer, Maine Highways Commission, Augusta, Me. Discussion by Alex Stewart, Supt. Ottawa Improvement Commission, Ottawa.

Evening Session

Annual general meeting, Canadian Good Roads Association, for election of directors and officers, and reception of annual report and financial and other reports.

THURSDAY, MAY 22nd

Morning Session

"Schools for Highway Engineering," by Prof. A. T. Laing, University of Toronto, Ontario.

"Drainage," by Geo. Diehl, Chief Engineer, Erie County, Buffalo, N.Y.

"Construction and Maintenance of Macadamized Municipal Roads," by A. Paradis, C.E. Engineer, Province of Quebec, Highways Department.

"Macadam Roads." by A. P. Sandles, Secretary, National Crushed Stone Association, Columbus, Ohio.

Luncheon and drive at noon.

Afternoon Session

"Keeping the Highways Open in Winter." by Hon. Frank Carrel, Quebec.

"Road Machinery." by Prof. A. H. Blanchard, Consulting Engineer, New York City. Discussion by E. Fafard, Supt. Plants Branch, Highways Department, Province of Quebec.

"A Comparative Study of the Different Methods of Transportation of Road Materials." by E. W. Gauvreau, C. E. Engineer Province of Quebec, Highways Department.

"Contracts, the Contractor and Labor vs. Government Construction of Trunk or Main Roads." by Col W. D. Sohler, Chairman, Massachusetts Highway Commission, Boston, Mass.

Speed in Driving Mine Tunnel

Force of Circumstances Made Rapidity Essential in Construction of Haulage Level in British Columbia Mine

VERY rapid progress was made in the driving of the main haulage level at the Copper Mountain Mines of the Canadian Copper Corp., Ltd., near Princeton, B.C. Conditions were unfavorable for economical operations. The cost of power was high, for the fuel was of poor grade; besides, during the time the work was in progress, very little other power was needed so that most of the power cost was charged against the footage. The transmission line consisted of No. 4 galvanized iron wire with the result that the line loss was considerable. The voltage transmitted was about 30,000. The plant was operated under a lease, which was due to expire about the same time this work was supposed to be completed, and as an extension was refused, speed was most important.

The plans called for a straight adit 2,900 ft. in length. At a point 2,800 ft. from the portal, two raises were to be put up to the next nearest workings, a difference in elevation of about 800 ft. One of these was to be a 2-compartment hoistway and the other a zig-zag ore pass, or muck run. A location for these raises had been determined by a number of diamond-drill holes, but the material to be penetrated by the adit was not known. It seemed imperative to get the tunnel work completed as rapidly as possible, in order to allow for delays in the raising program, which were certain to occur. To show how closely these operations were timed, it is interesting to note that the date of expiration of the power-plant lease was Sept. 1, 1918, and the last round, making the connection between the upper and lower workings, "broke through" in the night of Sept. 3, 1918.

Overbreak Retarded Progress

The plans called for a tunnel 9 ft. high by 11 ft. wide; but owing to the "blocky" nature of some of the rock a considerable "overbreak" occurred. This enlarged the tunnel cross-section to 10.4 ft. by 12 ft. indicated by measurements taken at 200-ft. intervals after the work was finished and slowed up the work on account of the extra waste handled, besides increasing the cost per foot of driving. Several regions of geological disturbance were crossed and the heavy ground encountered called for timber supports. More than 350 ft. of heavy timbering was necessary at vari-

ous points along the course of the tunnel; this also retarded the work to the extent of about 6 ft. per day for each set of timber placed. Once the working force was organized and the work well under way, three shifts were put on, working 8 hours each.

The drills used were the dreadnaught No. 60. They were mounted four on a horizontal bar, from which position all but the four bottom holes or "lifters" were drilled, the miners working on the muck pile. Upon completion of the upper part of the round, most of the muck had been removed; that which was left was rapidly thrown back from the face, all hands helping on this work. The horizontal bar was then torn down and dropped to the lower position, from which the lifters were drilled. The change of the bar from the upper to the lower position, together with drilling the lifters, loading, and firing the entire round, was frequently made in 50 minutes. The holes were pointed to pull a 7-ft. round and averaged about 9 ft. in depth. The centre, or "cut holes" were fired first, after which followed the side holes, then the back holes, and finally the lifters. The blasting was done by hand, the fuses being "spit." The timing of the shots was regulated by cutting the fuse in different lengths; the shortest for the centre holes, the next longest for the side holes, and so on. The lifters were loaded with extra heavy charges of powder, so as to throw the muck back from the face as much as possible. This was sometimes helped by placing charges of explosive outside and beneath the lifters; these were called muckers, and were set to go off after the rest of the round had been fired.

The powder used was a non-freezing kind, varying in strength from 40 to 60 per cent. nitroglycerin, depending on the hardness of the rock at the face.

Muck Removal

The rock was handled in small, V-shaped, hand-dump cars of about 1,000-lb. capacity. Trimming was done by hand until the distance from heading to dump became too great, when horse haulage was substituted; later this was replaced by an electric installation. Steel plates were laid on the bottom for a distance of 30 to 40 ft. from the face, to facilitate shoveling, also to permit shunting empty cars past the loaded trains and thereby eliminating the need for double track.

The cars, being light, were easily pulled from the track and, with bodies tilted, were passed on the steel plates, alongside of the loaded cars and then pushed back on to the track at the muck pile and loaded. Temporary track was laid close up to the face before firing a round. The T-rails were laid on their side, allowing the flanges of the car wheels to run on the grooves thus formed.

The foul air and gases were removed, after each round was fired, by a Connersville rotary blower, of 10 cu. ft. capacity, stationed at the portal of the tunnel. Later, a similar machine was placed about halfway in the adit and worked in tandem with it. The blowers were set to exhaust toward the surface through a 12-in. wire-wound, wooden stave pipe. The men were able to return to the heading within 15 minutes after firing.

The mucking crew was divided into three gangs, on each shift, averaging 11 men per shift. The work was divided so that one gang was shoveling muck, another was picking down from the muck pile, while the third was bringing up empty cars and forming

them into trains after they were loaded. This latter work did not take up the entire time, so that this gang had an opportunity to rest. As soon as a train was loaded, the gangs changed jobs; that is, the pickers went at shoveling, the car handlers took the picks, and the shovelers took the easy work, and so on. Greater efficiency was maintained in this manner, as the change of work tended to rest the men and they were able to work continuously.

Bonus System Speeded Work

A bonus system was also a large factor in keeping the men up to the mark. This was based on a daily advance of 9 ft., upon which the then "going" wages were guaranteed; for all advance over 9 ft., \$6 per foot was added as bonus. For each set of timber placed, an allowance of 3 ft. was made, which applied on the bonus. Current wages at the time were \$4.50 for miners, \$4 for helpers, and \$3.50 for common labor. The bonus distribution brought these amounts up to \$5.91 for miners, \$5.25 for helpers, and \$4.59 for muckers. The foreman and the shift bosses also shared in the bonus, the distribution being made by pro-rating the bonus in the same ratio as the amount of regular wage received by each man. Everybody seemed satisfied and no difficulties were experienced as far as the labor situation was concerned.

The work was begun on Oct. 9, 1917, and the tunnel was finished March 11, 1918, a total of 154 days. The actual working time was 150 days, four days being lost on account of a break in the power line.

The length of the adit is 2,903 ft. and the daily average progress was 19.3 ft. for each working day. The greatest advance in any one month was in December, 1917, when a total of 645 ft. was driven. The amount of rock handled is estimated at 185 tons per day. The material penetrated was granodiorite, for the greater part of the distance. The total cost of driving the tunnel was \$103,242, which brings the cost per foot of tunnel to \$35.56. Certain equipment and supplies were charged against the work that should have been carried in a suspense account, as most of these had a certain salvage value because it was intended to use them in the future operation of the mines. For reasons already mentioned, such as expensive power, the cost given does not really represent the actual expense of driving. Had speed not been so important no doubt the work could have been done more cheaply. A few of the cost items are as follows:

Total Driving Cost:	Totals.	Per ft.
Labor	\$25,517	\$ 8.80
Explosives	16,616	5.72
Drills, parts and repairs	2,767	0.95
Steel, sharpening and replacement	3,979	1.37
Miscellaneous supplies	1,908	0.66
Power	8,410	2.90
	\$59,200	\$20.40
Rock Disposal:		
Labor	\$21,843	\$ 7.52
Supplies	1,685	0.57
Power	558	0.20
	\$24,087	\$8.29
Timbering:		
Labor	\$1,335	\$ 0.46
Timber and supplies	2,513	0.86
	\$ 3,848	\$1.32
Indirect Expense:		
Air and water lines	\$ 5,439	\$ 1.88
Electric lighting	1,018	0.35
Ventilation	3,198	1.10
Dump, tracks and trestles	503	0.17
Depreciation on drills	970	0.33

Depreciation on cars	301	0.11
Surface hoisting and hauling	3,464	1.19
Miscellaneous supplies	1,208	0.42
	\$16,105	\$ 5.55
Total cost	\$103,242	\$35.56

Timbering Details:

53 sets timber installed, cost per set	\$72.62
354 ft. of tunnel timbered, cost per ft.	10.83

Drilling Details:

Actual drilling hours	8,022
Actual working days	149 11/12
Average drilling hours per day	53.50
Cost of upkeep per drilling hour, in ct.	22.53

The methods employed in this work were described by Mr. Oscar Lockmund in a paper presented before the American Institute of Mining Engineers.

Federal Settlement Board to Build Cheap Homes for Veterans

PLANS have been completed by the Federal Soldier Settlement Board for supplying standard houses to soldier settlers in the Prairie Provinces.

Four types are contemplated, ranging in price from \$300 to \$775, beginning with a moderately convenient and comfortable two-roomed house suited to the need of a bachelor settler, which can be erected for \$300. This house is 17' 10" x 14', and is so constructed that as the home needs of the farmer increase he can add to it without waste of material used in the original construction. This house is called type "A".

Type "B" is merely an extension of "A," one room being added and basement excavated. This building, which has dimensions of 25' x 14', when completed will cost approximately \$590.

Type "C" is "B" with a portion of the roof lifted and an upstairs bedroom added. Total cost, \$700.

Type "D" is the same as "C" with the remainder of "B" roof lifted and two extra upstairs bedrooms added. The cost complete of "D" is approximately \$775. This type of house will give the farmer living-room, kitchen and parlor downstairs and three bedrooms upstairs. If, in the course of time, he requires a still more pretentious home, plans are being prepared by the Board for a wing, which will give him a much more commodious and comfortable structure.

Cheap and Commodious

When a settler is ready to go on his land, he has the opportunity of selecting the type of house he requires and is given full particulars as to the cost and amount of lumber required for construction. As previously announced the settler may buy from any of 1,200 lumber dealers in the West at greatly reduced prices. He may erect his own house, or may ask the Board to do it for him. In any case, construction will be under the supervision of the Board's architect.

From three to eight days, according to the type, will be required to complete one of these houses, if building materials are on the ground. In the case of grouped farms, where a number of settlers may propose to locate together and build together, there will be material reduction in cost of construction.

The Board also plans to erect standard stables and implement sheds at the lowest possible cost to the settler. A settler may get along with a stable say 24' x 12', sufficient for the housing of two cattle and four horses, erected at a cost of approximately \$200. The plans are so drawn that these buildings can be enlarged without loss of material.

Montreal General Contractors Discuss Prices

THE question of lower prices for building materials was reported on by Mr. K. D. Church at a meeting of the general contractors' section of the Association of Montreal Building and Construction Industries. A special committee had this matter in hand, and Mr. Church reported that some manufacturers had been approached, and it was hoped in a short time to announce reductions on at least two classes of materials which entered largely into construction work.

Mr. J. B. Reid submitted a report on the request of the union of bricklayers, masons and plasterers for the adoption of a scale of work which would be satisfactory to firms and men. It was decided to request the Board of Directors to call a general meeting of the general contractors and sub-contractors, in order to discuss the prices to be paid for different classes of work during the present building season.

Freight Cars Now Made of Concrete

NEW uses for concrete come frequently to public notice. One of the latest, and one that promises to be far-reaching, is the concrete freight car. The beginning of practical plans for the manufacture of reinforced concrete freight cars dates from 1909 when a patent for such a car was granted to Joseph B. Strauss, of Chicago.

On account of the war, construction of a trial car was delayed, and it was but recently that the first car, of the gondola type, was completed by the R. F. Conway Co., Chicago, and tested under service conditions. Not only in the material used, but in its design and the details of construction, it represents an interesting departure from usual methods.

The basic feature of the design is a steel skeleton body forming the outer boundary of the car, and



First Concrete freight car proves serviceable

mounted upon a steel underframe. The concrete walls and floor are contained within this frame and, together with the frame and floor reinforcement, are connected to, and interlocked with, the underframe. The steel frame forms the finishing and protecting edges, thus entirely shielding the concrete and also serving as a complete system of stress-bearing members.

In the construction of the test car, the "cement gun" was used. The forms were placed on the outside of the car, and the cement was shot against them from within. The outside of the car, that is, the surface against the forms, was given a smooth finish, but the interior was left much as it came from the gun.

Tests of the completed car, both empty and loaded, demonstrated its practicability for rough service. In the test without load it withstood extremely rough handling in switching, and came through without injury. Subsequently, the car was loaded with fifty-five tons (10 per cent overload) of sand and turned over to a switching crew for service handling. It withstood this test also without injury.

Other merits are claimed for the concrete car. It will not need painting and will practically eliminate maintenance charges. Its life will be much longer than that of the wooden car. It will have the important advantage, also, of being unaffected by its cargo, and will consequently be adapted better than the steel car for hauling slag and ashes.

Plans already under way for the quantity manufacture of these cars. The fact that the first one was built with the sanction and co-operation of the United States Railroad Administration, and that the Illinois Central Railroad took an active interest in its construction and test, indicates that extensive production will not be long delayed.

Devices of Special Utility for Railroad Construction and Maintenance

AMONG a number of kinks of special utility in railroad service mentioned in a report on the Economics of Railway Labor submitted at the recent convention of the American Railway Engineering Association, there are many special devices that are of service to the maintenance and construction crews of the railroads. Some of these are mentioned:

Light Derrick—A light derrick handling a 3,000-lb. load that can be quickly mounted on an ordinary push car has been found to be a great labor saver in bridge gangs.

Straddle-Leg Pile Driver—This device was used on the trestle across Great Salt Lake. The structure was 12 miles long, carrying very heavy traffic and piles could not be driven with an ordinary car pile driver without great delay to trains and heavy expense for work trains. Floating pile drivers could not be used on account of the roughness of the lake.

Accordingly, an ordinary straddle-leg bridge traveler was adopted to pile driving purposes. The driver moves on rollers on the outer edges of the deck, the engines being placed on the upper platform and the leads are pivoted so as to swing in either direction. The trestle is of the ballasted deck type and is 16 ft. wide. The driver is 14 ft. 8 in. wide and 22 ft. high in the clear, making it possible for trains to operate through it without interfering with the driving.

Erection and Repairs of Water Columns or Removal—This kink consists of a collapsible A-frame made of 2-in. and 2½-in. pipe and guyed two ways with a 1-in. rope, to carry the overhead blocking necessary to hoist the parts in place. Ordinarily a long wooden tripod is used for erecting any part of the crane and setting this up requires at least four men. The length of these legs is 22 ft. If the crane is in an isolated place and is an important water station, it is expedient that the new parts and the tools for replacing them be hurried along by passenger train. With two such collapsible legs made up of a 12-ft. length of 2½-in. pipe with 12-ft. extension of 2-in. pipe and enough tackle and rope to guy the frames both ways, two men

can handle any part, and easily place it in the baggage car of the train.

Shackle Band for Repairing Timber Trestles.—

This is a device used on timber trestles where caps are in need of renewing or the stringers need shimming on account of the settling of the bents. A shackle band is made of 1-in. x 4-in. iron bent so as to fit over an upright post of the bent itself. Another shackle band is made to fit inside the first and held there by a 1-in. bolt. The back of the smaller band is sharpened somewhat in forging, so that it will grip the 12-in. timber as soon as any weight is put on it.

The bolt is removed when the device is to be used, the larger band slipped around the 12-inch x 12-inch, and the inner band put in place. It can be put around the bottom of a 12 x 12 post, and two men can raise it to the required height. After the weight of the larger band is taken by the sharp edge of the smaller it grips the timber and the grip increases with the weight put on it. Two such bands will make a scaffold that will raise any set of stringers. If a joint comes over the bent all that is necessary is to chain both sides of the rail and lift rail and all. Then the bent is free to take off the cap or even replace one of the posts if necessary.

Rail Unloader.—This consists of an apron and hook for unloading rail endwise from flat cars. A chain is used with hook on one end and a bolt that can be put through a hole in the rail at the other end.

The hook is set over the end of a splice in the track and as the car is moved slowly forward the rail is unloaded, and the sloping pieces of the apron guide the rail to the side of the track outside of the track rail.

Machine for Replacing Bridge Ties.—This device consists of a horizontal 20-ft wood boom set in a steel underframe on which is mounted a windlass operating grab hook by means of a system of cables and pulleys, the whole machine resting across a push car above the ties to be replaced.

The base is an 8-in. channel iron 12 ft. long, on each end of which is erected a ¾-in. x 4-in. stirrup or U-shaped iron, riveted through the bottom of the channel. Between the uprights of this stirrup are two rollers 6 in. in diameter placed about 6 in. apart. Between these rollers is a wooden boom 5 in. x 6 in. x 19.6 ft., with a 4-in. sheave in each end, over which a ¾-in. wire cable runs to two small flanged pulleys 4 in. in diameter with cranks attached. This is for hoisting or lowering the ties. The pulleys have notched edges on one side in which a dog engages to hold the tie at desired height. There is a pulley on the channel iron just at the edge of push car. This has ¼-in. wire cable two turns around and locking, and is used to extend or draw in the boom. There are grab hooks on end of cable for fastening to ties. The machine is also supplied with anchors from end of channel iron which hook under guard rails. It is only necessary to use this when removing or replacing caps to keep machine from tipping over.

In replacing ties, the old tie coming out balances the new one being put in and anchors are not required. In replacing ties small quick-lifting jacks are used, set on the stringers between the ties and raise ties clear of the stringers about 2 in.

It is said that this avoids the necessity of removing guard rails, and that 80 ties have been placed with it by six men in one day. The push car is equipped

with a plate fastened to deck of car, through which a king bolt is inserted, thus allowing it to be swung at an angle. It can be lifted off the car readily.

Lime Has Manifold Uses

NINETY-ONE prominent uses of lime in the industries were recently mentioned by A. D. Whipple, director of the Chemical Bureau of the Lime Association at a meeting of the Advisory Committee on Chemical Lime. This list of uses is tabulated as follows:

Building and Construction	Chloride of lime
Plaster	Disinfectants
Mortar	Prevention of putrefactive ferments
In concrete	Metallurgy
Stucco	Iron blast furnace flux
Gypsum products	Steel manufacture
Sand lime brick	Steel purification
Slag brick	Smelter flux
Agriculture	Aluminum manufacture
Direct use on the soil	Brass manufacture
In prepared fertilizers	Metal pickling
Lime and wood ash mixtures	Refractory and Insulating Materials
Insecticides	Cintered or dead burned dolomite
Spraying material	Ganister brick
Bacteria (protection of)	Basic magnesium carbonate
Caustic Alkali Works	Coke and Gas Manufacture
Soda ash	Coal gas and water gas purification
Caustic soda	Coke oven by-products
Potash salts	Gas plant by-products
Ammonia	Glass Manufacture
Chemical Works	Window glass
Manufacture of acids	Plate glass
Calcium acetate	Bottle glass
Sodium cyanide	Optical glass
Potassium cyanide	Glass tubing
Calcium carbide	Sugar Manufacture and Refining
Alcohol	Tanneries
(dehydrating of)	Oil, Fat and Soap Manufacture
(manufacture of)	Soap
(Wood distillation)	Lubricating grease
Bleaching powder	Candles
Magnesia	Renovation of grease
Bone ash	Renovation of butter, etc.
Phenol	Neutralizing acidity of oils
Barium products	Paper Industry
Precipitated calcium carbonate.	Soda process
Salt refining	Sulphite process
Explosives	Sulphate process
Cyanamid	Rag process
Nitrates	Straw board
Gelatine	Miscellaneous Industries.
Glycerine	Glue manufacture
Preparation of gun cotton	Pottery manufacture
Paint Manufacture	Porcelain manufacture
Calcimine	Polish and buffing compounds
Whitewash	Corn products manufacture
Cold water paints	Cotton and thread mills
Putty	Print works
To hold heavy materials in liquid suspension	Flour mills
Sanitation	Medicinal and proprietary uses.
Water purification	
Water softening	
Sewerage and garbage purification	
Neutralization of acid waters.	

According to the report of the Minister of Public Works of the province of British Columbia, some bridge-work was undertaken by contract during the past year, and it is the intention in future to have all such work done by contract wherever practicable. The dearth of efficient bridge foremen has been partly responsible for the day-labor work costing more than was anticipated.

Commission of Five Administer Montreal's Housing Scheme

AT the invitation of the Administrative Commissioners of Montreal, a conference of representatives of local public bodies was held at the city hall on March 28, to discuss the appointment of a commission of five to carry out the Quebec Act for the construction of industrial houses. The Association of Montreal Building & Construction Industries was represented by Messrs. W. Rutherford, J. Quinlan, W. E. Ramsay, J. E. Walsh, J. K. McNutt, R. F. Dykes, A. W. Bremner, A. F. Daly, J. F. Parsons and D. K. Trotter.

Mr. Decary, the chairman, stated that about four million dollars will be spent in Montreal, and the Administrative Commissioners had decided to appoint a commission of five to carry out the Act. The Administrative Commission desired that the various bodies should submit names of men who would be willing to give their time gratuitously to this work, and the Commissioners would make a selection. A business manager would be appointed to take care of the details. He would be responsible to the Board, who in turn would be responsible to the city. It was necessary that the work should be properly supervised, and better industrial districts created.

In the discussion which followed the point as to various interests, including labor, being represented on the Commission was brought out, the general opinion being that it would be impossible to have such representation and that a small Commission was more likely to do more effective work than one composed of a large number.

The chairman emphasized the fact that the manager would be assisted by a number of practical men in the matter of the planning and building of the houses. The Commission favoured the direct labor system. The first call on the money would be for the working men. It would be the duty of the Commission to see that the houses were put up in accordance with the specifications and that they were properly built. The Commission would be assisted in this respect by inspectors who were experts in the various trades.

Mr. R. A. Ross said that the idea was to appoint five good business men, and no man in the city was too good for the work. The technical part of the work could be looked after by competent men.

The chairman then invited the public bodies to send in lists, so that the Act could be put into force at the earliest moment.

Government Urged to Construct French River Canal

Representatives from Northern Ontario at the Toronto convention of the Associated Boards of Trade of the province urged the advantages of the suggested French River canal. Mr. A. J. Young, of North Bay, declared that only three locks would be required and over 33,000 h.p. would be developed, which would pay the interest on the cost of construction. Another speaker stated that the value of the forests in the adjacent district was \$40,000,000. The saving in coal as a result of the power development would be \$1,250,000 a year. The building of the canal would save the \$6,000,000 that would be required to extend the Canadian National Ry. to North Bay, and insure the transportation of most of the 60 per cent of the Western grain, which is now transported overseas by the U. S.

railways by way of Lakes Superior, Huron, Erie and the American cities of Buffalo and New York. This transportation would be over a mileage shorter by 100 miles than the American lines at a cheaper rate. Following this discussion, a resolution to reaffirm the motion passed by the Boards of Trade on Feb. 23rd, 1912, that the Dominion government be urged to begin as soon as possible the construction of canal systems on the French River, was carried.

Mons Presents Montreal Soldier-Contractor with Flag

General F. O. W. Loomis, of the contracting firm of D. G. Loomis & Sons, Montreal, has been presented by the municipal council of Mons with a flag in which, in addition to symbols associated with the Canadian army, is inscribed the names of famous towns where Canadian soldiers particularly distinguished themselves. Gen. Loomis is the general commanding the Third Canadian Division, which formed part of the first army which liberated Mons on November 11th. General Hanoteau, who represented the King of the Belgians, invested General Loomis with the insignia of Commander of the Order of Leopold.

Robertson-Olsen, Limited, to Manufacture Sheet Metal Materials

Robertson-Olsen, Limited, which, as previously announced, was incorporated on Feb. 1st, with a capital stock of \$100,000, has taken over the old Lindsay plant at the foot of Cherry street, Toronto, and is there establishing the head office and works. The company manufactures Kalamein doors, windows and mouldings, seamless bronze doors, steel doors, sash and mouldings, Underwriters' labelled doors, windows and rolling steel shutters, and many other lines of sheet metal building materials. Mr. Robertson and Mr. Olsen have had long experience in this line of business, both having previously belonged to the firm of McFarlane-Douglass, Ottawa, and they intend to push their products aggressively this season. Their present plant is well-lighted and operated by electricity, and they are equipped to manufacture, erect and install all their products. Within the next few months, also, they intend putting up additional buildings on the adjacent property, which will more than double their present capacity. The proposed expenditure will run into about \$50,000.

Trade Incorporations

Superior Roofing Co., Toronto—partnership registered.
Hyatt Steel Products, Ltd., capital \$300,000, Vancouver, B. C.

The Greater Victoria Building Society, capital \$480,000, Victoria, B. C.

Architectural Builders Limited, have been granted a charter. Head office Toronto

A. R. Williams Machinery & Supply Co., Limited, capital \$500,000, head office Montreal.

The F. C. Burns Construction Company, Limited, Toronto, have been granted a charter.

H. M. Lane Company, Limited, capital \$10,000, Windsor, Ont., to carry on the business of consulting engineering, designing and construction work.

Messrs. A. Dell'Angela and E. D'Esprit have formed partnership to be known as the Ontario Mosaic Terrazzo & Tile Co., and have opened an office in Toronto.

Industrial Relations—Capital's Viewpoint

Fair-minded Employers and Fair-minded Workmen are Looking at Problem in the Same Light—Extremists are to be Feared

THE CONTRACT RECORD of April 2 contained an abstract of an address by Mr. Tom Moore, president of the Dominion Trades & Labor Congress, on "Industrial Relations—Labor's Viewpoint." This address was presented on March 24 at the annual meeting of the Joint Committee of Technical Organizations. At the same meeting the employers' side of the labor problem was taken by Mr. J. F. M. Stewart, former secretary of the Canadian Manufacturers' Association. The paper which Mr. Stewart read is reprinted below:

A few years ago one would assume that the observations of the President of the Trades and Labor Congress of Canada and of an ex-secretary of the Canadian Manufacturers' Association on practically the same subject would be diametrically opposed. During the last few years, however, the attitude of the community, which includes all the elements which are bound together in industry, call these elements what you may, has changed very materially. To-day the reasonable, fair-minded labor man and the reasonable, fair-minded employer are looking at the big problem of the rights and obligations of what we generally describe as the workman through pretty nearly the same size of spectacles.

Extremists are to be Feared

The reasonable man on either side of this question is not to be feared, but unfortunately there are extremists. There are employers and superintendents, and I am thankful to say they are becoming fewer, who cannot keep step with the changing conditions. These men see what has happened in Russia, in middle Europe, and what is happening in the British Isles to-day, and they start out to prevent such disaster and destruction and suffering, by assuming an attitude of hostility to the requirements of the men on the payroll. To these men we can only say that the great social problems that have arisen are up for settlement and they cannot be settled by a fight. Fighting means anarchy; fighting is not civilization and we are not barbarians.

It is quite likely that conditions in Russia would not be what they are to-day if capital had recognized the rights of workmen and of the community and had sought counsel and advice from them. So in England, where social legislation is far in advance of legislation on this continent, it is possible that an earlier recognition of changing conditions might have stayed the tide that now threatens England's supremacy as the manufacturing nation of the world.

The extremist on the labor side is probably the more dangerous. The employer who is an extremist is usually passive and standing firm, while the laboring man who is an extremist, is carrying on a campaign advocating force, extreme socialism, Bolshevism, or the same thing by whatever name you may call it. I was at a meeting not long ago when the alien problem was discussed and the statement was made, and I am in full accord with it, that the aliens in Canada who have been made rich by war wages, while our own boys were risking life and limb for us at one dollar and ten cents a day, would now have to stand aside and let the returned boys have the factory positions. Replying to this a young man of foreign extraction in great heat arose and extended his arms, spread his fingers, stuck his head forward, forced his flashing eyes until they bulged from the sockets, and stated the alien question was dead, there were no aliens, he was a citizen of the world; and then modifying

his statement somewhat, he said the only aliens were the employers, who were alien to anything and everything that would benefit the working men, and then away he went again, and stated the time was coming when the industries would be seized by the people and the employer would get his just deserts. Unfortunately this speech was followed by considerable applause. Now here is one place where the workmen and the employers can join shoulder to shoulder and wage war. Intelligent Canadian labor, as I see it, has no more in common with those sentiments than the employers have.

Social Structure Cannot be Rebuilt in an Hour

The extremists are the dangerous elements. The fair-minded and progressive employer recognizing his duty to his fellow men must dissociate himself from the extremists, and labor must fight to keep its ranks free from the class of men I have described. It is not the reasonable employer that Mr. Moore and his associates are opposing, and the reasonable employer to-day is most grateful that recognized labor organizations have at their head men like Mr. Moore who have great faith in our country and our people and who do not believe that the social structure can be destroyed and rebuilt in an hour.

In this democratic country there is no class distinction which draws a line between the workman and the employer. Our industrial development is in its infancy and the man in charge of a plant today was a workman yesterday. There are very few men in this land who have not earned their daily bread by the sweat of their brow and consequently, the problem of labor to them is very real. This fact, I believe, will be of the greatest benefit in the settlement of our industrial difficulties.

Not much is to be gained by reviewing labor conditions during the war as the situation was abnormal, but labor will admit that the factories of this country launched into the making of munitions in a way and with results that called for the admiration of all Canadians and caused the whole world to recognize the factories of Canada as a permanent factor in the trade of the world. When the armistice was signed labor was nervous and fearful of unemployment. Employers were anxious and fearful of unemployment. Capital cannot get a return in times of depression. Labor cannot be satisfied unless it is continually employed under favorable conditions. Be it said to the credit of labor, during the months of readjustment that the manufacturing industries have been wrestling with, that labor has, on the whole, played fair and generally speaking has co-operated in this enormous task. Let it also be said to the credit of the manufacturers that they never tackled a problem with more serious misgivings and more anxiety or with more determination than they have tackled the problem of peace readjustment. And further, throughout all their efforts, the question of the high cost of living and high wages have been before them and their plans have assumed as a settled fact that a reduction of wages which must inevitably come must not come now. This co-operation of labor and factory management is a very bright spot on our industrial record and is bearing magnificent fruit.

There are no soup kitchens in Canada today. There will always be some isolated cases of hardship, but they are very few. There are not thousands clamouring for work.

Please do not take it from my remarks that there is no unemployment, but rather the thought I wish to leave is that the unemployment today is very much less than any of us expected would be the case when looking ahead a few weeks ago. There are no unemployment demonstrations that are of moment. As a matter of fact, I venture the statement that the unemployed in Canada this month is less than the average unemployed in the same month during the last ten years. In a prominent evening paper there are two full pages of advertisements for help wanted. This condition is gratifying to us all and particularly so, when you realize the immensity of the task of providing work at high wages for the hundreds of thousands of munition workers and the tens of thousands of soldiers, who are being welcomed home. How wonderful it is to be able to welcome these soldiers to a prosperous country rather than to a land of depression and lack of opportunity. I am not a prophet but, having regard for present day conditions in this country which are not bolstered up in any way, I would predict that when Canada's real effort gets under way by, say, the middle of this summer, there will be a real shortage of workmen.

The immediate and pressing need for capital and labor is to keep firm and steady; neither the one nor the other must make a false step. Unitedly the problem for more and more industrial activity must be faced. For us all to be happy we must all be busy; the development of our own country and the sale of our products to the world is a task that can and will be achieved, and in its achievement labor will be rewarded and capital will get its fair return.

In asking labor and capital to stand firm I believe we can reasonably ask the farmer who has not done badly the last few years not to dislocate industry by radical demands for tariff lowering. Personally I have never been a high tariff advocate but I sincerely believe that anyone today who would let down the tariff barrier and flood this country with foreign-made goods and stifle our own industries and put our own men out of employment must be prepared to assume an awful responsibility. In asking labor to stand steady I do not suggest for a moment that the problems of labor must be relegated to the background; far from it; the people of Canada are vitally interested and sympathetic and out of hard thinking and reasonable discussion practical solutions will evolve.

Disapproval of Short Workday

Not many suggestions that have been made as yet are applicable to Canada. Hours of labor have gradually been reduced and employers recognize that this should be so. However, to make the working day in Canada six hours as has been proposed is not possible. Unemployment does not warrant it. Men's physical comfort does not need it. The result would be that the cost of products would soar to unheard-of prices and Canada would be quite eliminated in its efforts to manufacture for foreign trade. Further the products of our Canadian factories would be in competition in the local market with products produced more cheaply elsewhere and the present customs tariff would not afford sufficient protection to enable our manufacturing to continue.

Dealing with this phase of the problem let me read the opinion of Premier Lloyd George given to Bristol Labor Unions and which is well worth repeating: "There is a feeling that one way of providing employment is by reducing the hours of labor, so that there will be enough work to go around on the same wages. Reduce the hours of labor to what is fair, profitable and possible, but to reduce the hours of labor merely in order to provide employment, paying exactly the same wages, is one way of making unemployment in the whole country. I should have thought that stood to reason. It is so elementary. It increases the cost of a particular commodity and that commodity is an ingredient

in something else. If you put up the price you diminish the purchasing capacity, you diminish employment. And not only that, for, as I have pointed out, you destroy overseas trade upon which this country depends more than any other country in the world. I despair if the working classes of the country do not recognize that elementary and fundamental principle, but I am sure that they do. If in the end you increase the cost of everything, you will only do what happened in Russia—where the workman seems to be getting sumptuous wages. They ran up to the most splendid figures. What is the good of these, inflated, puffed-up wages, which are all paper?"

Minimum Wage Objectionable

Another proposal of labor is for a minimum wage fixed by law. A definition of a minimum or basic wage which appears to me most fair is given in a report on labor problems by British Quaker Employers as follows: "The wages paid to a man of average industry and capacity should at least enable him to marry, to live in a decent house, and to provide the necessities of physical efficiency for a normal family, while allowing a reasonable margin for contingencies and recreation."

The fixing by law of a minimum wage is difficult for at least two reasons:

(1) What is going to become of the unfortunate who is not a man of average industry and capacity?

(2) This enormous land of ours embraces so many and varied conditions of life and industry that the cost of living in different localities is very different. And within a comparatively short radius this is very noticeable. I do not believe a workman in Toronto earning \$4.50 per day is able to live at as high a standard of comfort as the man in small towns within a radius of a few hours from Toronto who earns, say, \$3.00 per day.

My own view, further, is that a minimum fixed wage would tend to also become the maximum wage paid which would be unfair to the clever and ambitious workman. Various plans of profit sharing and bonuses have been advocated and no doubt they all have some merit but the average workman prefers to know what his wage is and to get it regularly and the great objection to profit sharing is that industries are frequently operated at a loss and the workman while possibly prepared to share a profit is in no position to share a loss.

Although some suggestions do not appear practical, I believe there is much that can be done. I am strongly of the opinion that workmen must be taken much more into the confidence of the management of industrial plants. Contrary to the general opinion not many manufacturers make more than a reasonable return on the funds entrusted to them. Many lose money—some fail. It is not to our credit that the few who make great successes are marked men and called uncomplimentary names.

Take Workman Into Confidence of Employer

The workman today claims from the employers and managers the clear recognition of his rights as a person. He is entitled to this. The management has no right to assume that the interest of the workman in his work and surroundings is not equal to its own. It is fair and right that the workman should have a proper and recognized way of presenting his viewpoint and in all problems connected with production, processes, engagement and dismissal of employees, hours of work, rates of pay, welfare work, shop discipline and relations with trade unions, his honest opinion should be received in a recognized conference by the management. But in order that these problems are settled fairly the workman must take into consideration the competition his employer has to meet with nearby factories and with the world at large. His breadth of view will develop with ex-

perience and it must be kept in mind that such a shop committee could stifle an industry or could bring it great prosperity. It is reasonable to trust the workman and to assume that he appreciates his associations with a prosperous industry. A representative committee in any of our large plants would have men on it who would be quite as qualified to express opinion on the problems suggested as the management, and with all the facts before them, just as quick to appreciate that certain suggestions could or could not be carried out.

The problems are many and to the heads of the Trades and Labor Congress we are today looking for sane guidance. It is the duty of us all to think hard and not to stand still. We must progress. The issue in the world today will not be settled by deceiving ourselves and refusing to admit that there is an issue.

Social Legislation

I am of the opinion that there is certain social legislation that the country could well embark upon at the present time. It is only a few years since Ontario adopted a Workmen's Compensation Act which is a direct tax on industry and which has practically the unanimous endorsement of the employers of the province. This has resulted in the greatest good to the many who have suffered industrial accidents.

Again, any man in Canada who works until he is beyond the age when he can continue at his work, say sixty-five, has been of benefit to the community. If he is not in old age in a position to pay his way the State should co-operate. No one in his declining years should be absolutely dependent on the kindness of his family or relatives. The State might well step in and co-operate with every such citizen. In fact, it might be well to earmark a portion of the income tax levied by the government and paid by the more fortunate for the purpose of securing the comfort of our fellow men during the declining years.

In conclusion let us remember that Canadian labor and Canadian capital are loyal. At heart they are both sound. Each believes the other is entitled to reward and both believe that the comforts of life will be more equitably distributed than ever before.

John Rockefeller, Jr., in an industrial creed states thus: "I believe that labor and capital are partners not enemies; that their interests are common interests, not opposed; and that neither can obtain the fullest measure of prosperity at the expense of the other, but only in association with the other."

The workman and the employer who have the wonderful privileges of living today in this great country of promise have very great responsibilities. Our agriculture, mining and industrial industries are only now being developed. Our national progress and apparent prosperity will be in vain if along with it the community does not advance as a whole. Working together, capital and labor can make this country the happiest home on earth.

The members of the St. John Valley Railway board are demanding the payment of \$50,000 by the Nova Scotia Construction Co. for failure to complete the St. John Valley road from Gagetown to Westfield by Nov 30th last. Representatives of the Nova Scotia company and the Bedford Construction Co., sub-contractors on the work, have petitioned the government that, because of the scarcity of men and unavoidable delay, the time for completing their contract be extended and that they be permitted to complete the work on a "cost plus" basis. Last July the contractors entered into an agreement with the railway to pay liquidated damages of \$300 a day if the work was not completed by Nov. 30th, 1918.

Personals

Lieut. Chas. L. Coulson has been selected from a list of nineteen applicants as city engineer of Welland, Ont. Lieut. Coulson went overseas with the 98th Battalion and has not yet returned to Canada. He is, however, to receive immediate release from military service.



D. H. Fleming, who has been appointed city engineer of Owen Sound, Ont.

Major G. H. Whyte, M.C., well-known engineer, has returned to Canada after putting in three years' service overseas, and is now visiting his mother in Ottawa. Major Whyte enlisted and served with the 10th Canadian Engineers, and received his Cross for gallantry at Vimy Ridge, where he headed a working party on dangerous duty on a bright, moonlight night, throughout which they were continuously under enemy shell fire. He received his captaincy in May of last year, and was made a major in September.

Obituary

Geo. W. Cole, president Geo. W. Cole, Limited, steam specialists, and also of the Atlas Tank Works, Toronto, died recently.

Mr. Allen Fraser, of Winnipeg, chief engineer of the C. N. R. western lines, was killed, along with several section hands, by a snow-slide in the Rockies on Sunday, March 30th.

Mr. Joseph N. Arcand, ex-president of the Master Painters' and Decorators' Association, died in Montreal on March 27th. In 1909 and 1910 he was president of the Montreal Builders' Exchange.

Mr. Martin Ewald, Sr., of Preston, Ont., died recently in his eighty-fifth year. Mr. Ewald formerly carried on a building and contracting business, but for a considerable number of years previous to his death had retired from active work.

Mr. George Herbert Garden, a charter member of the Engineering Institute of Canada, recently died at Rouse's Point, N. Y. He was born at Woodstock, N. B., in 1849, and from the commencement of his professional career was identified with railway engineering. Mr. Garden did a large amount of work in all parts of Canada, his last position being in charge of location of a section of the lake shore line of the C. P. R. from Montreal to Toronto. He retired in 1914 owing to ill-health.

Mainly Constructional

East and West—From Coast to Coast

The Canadian Mathews Gravity Carrier Company, Limited, Toronto, are moving to Port Hope, Ont.

The construction of the military sanatorium at Woodbridge, Ont., is to commence in about a month.

A petition for winding up order in connection with the Mack Brick Co. Limited, Montreal, has been withdrawn.

The Neptune Meter Company, of New York, proposes establishing a Canadian plant. Hamilton, Ont., is chosen as the location, and a building is to be erected there shortly.

Hon. T. A. Crerar, Minister of Agriculture, recently intimated that it was the intention of the government to build a million-dollar cold-storage plant on the waterfront of Montreal.

The St. Thomas, Ont., Board of Education has decided on the erection of a one-storey four-room school, modelled after the schools of this type now in use in London, Ont., and Rochester, N. Y.

Notice was given at a recent meeting of the city council of New Westminster, B. C., of a motion to provide for the tearing down of all buildings in the city on which a life has been placed and has expired.

Sheldon's Limited, of Galt, Ont., have enlarged their plant by the addition of a new stock and pattern shop. The opening of this new building was celebrated by a dance which, it is stated, was one of the most successful in the history of Galt.

The work of demolishing the Sault Ste. Marie jail and court-house is now under way, with Bumbaco Brothers in charge of the work, at a price of \$14,000. A new \$250,000 structure will be erected, with the bulk of the work being handled by local contractors.

It is understood that the government contract for harbor improvements at Toronto, including the new turning basin, and completion of the sea wall between Bathurst Street and the Humber River, has been awarded to Roger Miller & Sons, Ltd., for about \$500,000.

Building permits for the month of March in the city of Welland, Ont., reach a value of \$24,950, as compared with \$6,030 for the same month last year. The total for the first three months of this year is \$54,355, while for the corresponding period in 1918 it was \$31,640.

The city council of Vancouver at a recent meeting decided not to go ahead with any housing scheme until the housing bill had been passed in the Legislature, and in the meantime the matter is left in the hands of the special committee appointed to deal with the question.

An architects' competition is to be held for the designs of the proposed memorial museum in Regina, Sask., under the direction of Professor Ramsay Traquair, professor of architecture at McGill University, who has been engaged by the government to work out the details of the competition.

A questionnaire was recently sent out to soldiers and their relatives in London, Ont., regarding the government's housing scheme, and 200 persons have indicated their desire to take advantage of it. In addition to the soldiers, 83 civilians have applied for the right to come under the housing scheme.

Carleton County has received authority from the Provincial Legislature to issue debentures to the amount of

\$100,000 to cover the county's share of the cost of a bridge to be built across the Rideau River, replacing the present Cumming's Bridge. The city of Ottawa will contribute a like amount.

A housing commission has been appointed by the council of New Toronto, Ont., consisting of three members: C. Lovejoy, Thos. Staunton, and Frank Longstaff. A by-law will be prepared by the council and the commission will take immediate steps to acquire plans and estimates of houses suitable for erection in that locality.

The question of a permanent site and more adequate accommodation for the University of Manitoba has been under consideration for a considerable time, and the announcement is now made by the board of governors that Tuxedo Park has been chosen as the site of the new buildings which are to be erected when conditions permit.

Replacing the old mill burned to the ground about a year ago, the Eburne Sawmills Company has now nearly completed one of the most modern plants on the Pacific coast in the vicinity of Vancouver. The new mill is 500 feet long, and is capable of turning out 100,000 feet of lumber daily. A 750 h.p. engine will furnish power to the plant.

Commissioner of Works Macallum is now calling for tenders for a new bridge across the Rideau River, to replace what is generally known as the St. Patrick street bridge. The new bridge will be approximately 500 feet long and 55 feet wide, carrying street railway tracks. Tenders are being invited on two types: the concrete arch type and the steel girder type.

The proposed \$250,000 bank building proposed by the Union Bank of Canada, at the Corner of Hastings and Seymour streets, Vancouver, will be three storeys in height, and will have a frontage of 52 ft. and a depth of 120 ft. The front elevation will be of an imposing appearance, four large columns rising to the top of the second floor, with the front entrance circular in shape.

The School Trustees (Protestant) of Verdun, P. Q., have received tenders for the extensive alterations to Bannantyne School. This addition comprises two wings and a modern power house. The estimated cost of the work is \$250,000. The new Rushbrooke School in the same city is going ahead rapidly and the roof is now covered. This is the only fire-proof school in Verdun.

Four hundred new houses are to be erected in Three Rivers, P. Q., this summer. The National Shipbuilding is undertaking to provide one hundred houses for its own employees and also to erect at least three hundred other such dwellings for the city, under the provisions of the federal housing scheme.

A heavily-signed petition has been forwarded to the president of the Canadian National Ry. Board by the farmers in the area of country lying to the northwest of Swift Current, Sask., between the main line of the C. P. R. and the Empress branch, demanding that work be started this year on the projected government line northwest to connect with the projected Medicine Hat-Hanna branch.

The building to be erected at the University of Toronto as a memorial to students and graduates who have done their part in the war, will consist of a bell tower, with an archway or hall and chapel, which will connect Hart House and the east wing of the main building. The tower will be about 100 ft. high, with an extra 35-foot minaret. A sum of \$225,000 has been set aside for the construction of this edifice.

The Saskatchewan Co-operative Elevator Company have

under consideration the erection of a 2,000,000 bushel addition to their terminal elevator at Port Arthur. The company, it is understood, will commence work early this summer. Although the contract has not yet been let, the plans and specifications have been approved, and definite announcement respecting the contract is expected at an early date.

The Fire and Light Committee of the city of Winnipeg proposes the erection of a garage and storehouse for the Light and Power Department. It is aimed, finally, to have a six-storey building, of which the cost would be about \$160,000. Possibly, however, several of the storeys will not be built this season, but left to be added at some future date. If the basement and one storey is constructed, the cost would be \$49,000; if two storeys, \$75,000.

A start has been made on a road to be built between Smith's Falls and Perth, Ont. The Suburban Area Commission has let the contract for quarrying, crushing and delivering of the stone to W. H. Code, of Smith's Falls, who is under instructions to rush the work. The road will be three miles in length, and the standard 18 feet in width. The cost is being borne by the province, county and town in the proportions of 40, 30 and 30 per cent.

Canadian steel prices have been lowered to correspond to those of the United States. A price bulletin was issued in Toronto recently placing iron and steel bars at a price of \$4.25 base, which is on the same basis as the American price in warehouse, plus freight and duty. Other prices announced in the bulletin were: Bands, \$4.50 base; hoops, \$5.00 base; angles, channels, beams, \$4.50 base; cold rolled steel, plus 25 p.c.; plates, 3-16-inch and heavier, \$4.50.

At the annual meeting of the Saskatchewan Anti-Tuberculosis league, when considering the needs of their institution, it was decided that the most necessary structure now is an auditorium, the erection of which will be proceeded with this season. The new auditorium will cost about \$35,000, and will be of two stories, the lower for club-rooms, lounge, can-tees, billiard and pool parlor, and writing-room; and the upper for a recreation-hall with seating for 200, and a stage and moving-picture screen.

Two proposals are under consideration in regard to the provision of further accommodation at the Parliament Buildings in Toronto, for which purpose \$200,000 has been appropriated. One is to add two storeys to the library of the north wing of the building and the other to erect a large office building at 17 Queen's Park, and join it to the main building by a tunnel. This building would be heated from the present plant in the Parliament Buildings. Plans for both schemes are now nearing completion.

The Board of Trade of Blenheim, Ont., is agitating for better fire protection and waterworks system. It is urged upon the town council that a competent engineer should be engaged to make an estimate of the cost. Deep wells are suggested as a means of procuring water; the present surface well system, it is pointed out, might result in an epidemic. It is also urged that a chemical fire-fighting apparatus be secured to work with the present system of waterworks. The council has decided to enquire into the cost of carrying out this proposal.

Work on the Union station of the Canadian National and Grand Trunk Pacific railways, which is to be constructed on Stadacona street east, between Third and Fourth avenues, Moose Jaw, will be commenced before the end of April, and it is expected that the new structure will be ready for occupancy about the end of October. Tenders have been called for by the C.N.R., and will close on April 14, and the construction work should start within a week of that date. The complete plans for the building are now at Moose

Jaw, and show a structure with an over-all dimensions of approximately 200 feet by 30 feet, the wings of the station to be only one storey in height, while the centre section will consist of two storeys.

While it has up to now been expected that the new building being erected on Bank street, Ottawa, by C. Jackson Booth would, in part, provide housing for a moving picture theatre, it is now learned that original plans to this effect have been changed. The building, which will be nine stories high, with basement, sub-basement and boiler rooms below the street line, will be given over to stores and offices. It will have a frontage of 100 feet and a depth of approximately 200 feet, and will be of reinforced concrete construction. The plans are not yet completed.

The local board of governors of the Alberta University, Edmonton, will suggest that a new building be erected at the northwest corner of the main arts building, similar in size and construction to the engineering building on the southwest. The governors decided to lay the matter before the government, in hope of securing new quarters in time for the next fall term. Considerable materials was reported to be already on hand, and the erection of a suitable building was not thought to be too heavy an undertaking for the coming season. If the request is granted, the building will be used for the new mining department, which is to be organized for next year's work.

Plans for the proposed memorial boulevard to encircle the city of Toronto are well under way and possession of about half the lands necessary for its construction has been arranged. The boulevard will start at Humber Bay, at the Lake Shore road, where it will join the harbor commissioners' waterfront driveway. From there it will go north pretty well along the line of the Humber River to Eglinton avenue, and thence diagonally across country in a northeasterly direction to York Mills, thence down the valley of the Don and over to Woodbine avenue, to again join the waterfront driveway. The distance from the Humber to the foot of Woodbine avenue will be 33 miles.

Contracts are being let for the grading of the new P. Burns railway which is to be run from Calgary into the great P. Burns coal deposits, in the foothills region southwest of Calgary, and it is understood that the grading work will be rushed to completion. The final survey is completed, and the actual team and rock work thereon will be commenced within the next few weeks. All winter men have been engaged in clearing the right of way of brush and trees preparatory to the commencement of the grading work, and the spring season will see much work of the latter character under way. It is a belief that the railway will be well along toward completion by the end of the present year; that is, with the exception of the laying of the steel, for the latter work will depend upon the possibility of securing steel rails.

GOOD ROADS ACTIVITIES

Hon. Finlay Macdiarmid, Minister of Public Works and Labor for the Province of Ontario, recently introduced two bills in the legislature to amend the Ontario Highways Act. One proposes to ease the limitation of expenditure on county roads, and the other provides a policy for applying the federal grant, approximating \$1,250,000, which the province expects to receive for provincial highways.

Hon. Dr. King, Minister of Public Works for British Columbia, speaking in the Legislature recently, said that in regard to the construction of a connecting link between the roads of the coast and the interior, a complete survey would be made to determine which is the best route. He intimated that when this had been done, substantial assistance towards the building of the roads is expected from the Do-

minion Government, and the Province would probably be in a better position to avail itself of this assistance than it is this year. Hon. Dr. King defended the policy of appointing district road engineers. This system, he claimed, increased efficiency and saved money. As proof of this he pointed out that in 1910, before the district engineers had been appointed, the upkeep of 7,000 miles of roads and 5,000 miles of trails cost \$1,371,794, while last year the expenditure for 14,000 miles of roads and 8,000 miles of trails was \$1,093,000.

A large and enthusiastic delegation recently interviewed the Ontario Government, requesting the construction of a provincial highway from Toronto to Sarnia, Ont. The Prime Minister in his reply intimated that the Hamilton to Windsor route had virtually been decided upon for the western portion of the trans-provincial highway, but that the Federal grant for road-building might enable the province to enlarge their programme and undertake a greater mileage of provincial highways than otherwise would have been possible. The delegation represented the following municipalities: Sarnia, Parkhill, Thedford, Forest, Mitchell, Seaforth, Clinton, Goderich, Stratford, New Hamburg, Kitchener, St. Mary's, Guelph, Baden, Georgetown, Brampton, Acton, Listowel, Palmerston, Hanover, and the counties of Lambton, Huron, Perth, Wellington, Waterloo, Halton, Peel, Grey, Bruce, North Oxford, North Middlesex and Huron. The following resolution, passed at a recent "Good Roads" convention in Stratford, was read by Mr. W. Hay, M.P.P.: "That this convention expresses itself as being strongly of the opinion that the construction of this provincial highway be undertaken immediately, and urges that the provincial government do at once proceed with this trunk line and commence survey work with a view to the construction of a feeder system which would accommodate the territory north of the proposed highway and east of Lake Huron."

The town council of Orillia, Ont., has let paving contracts amounting to approximately \$180,000, which covers work on five of the principal thoroughfares. The pavement will be of the bitulithic type and the Warren Bituminous Paving Co., of Toronto, has the contract for laying it. Currin and Clement, of Orillia, were awarded the contract for the storm sewers.

In order that road work may be better and more closely carried out the Quebec Provincial Government is working on a plan whereby the entire province would be divided into twenty-one districts for road work, each district to have its own residing engineer. These twenty-one engineers would be under the immediate jurisdiction of a head engineer, with headquarters at Quebec. The appointment of these twenty-one engineers is already being made, and announcement as to the formation and staff of each district will be forthcoming shortly. It is calculated each district would comprise three counties.

Victoria county, Ont., proposes to pave Queen Street east to the boundary of the city of Lindsay and Lindsay Street south to the boundary and to resurface Colborne Street during the coming season.

The council of Haldimand county, Ont., has appropriated \$100,000 for road work. The report of the Good Roads Committee, which has been adopted, recommends the carrying out of the following work: To construct the road from Wentworth county to Jarvis by contract; to complete the road from Nelles Corners to Cayuga; to construct two miles on the Indian line from Nelles Corners to the Fisherville side-road; to finish the road from Nelles Corners to Selkirk; to spend \$7,000 in gravelling the River road from Cayuga to Caledonia; to spend from one to two thousand dollars in laying a foundation in a quicksand bottom in the road near Bethel Church, Canboro', which is to be stoned next year; to continue construction on the Rainham road to South

Cayuga village. These roads, amounting in all to 22 miles, to be constructed during the year 1919.

A by-law has been passed in the Township of Charlottenburg, Glengarry county, Ont., to provide for permanent road improvement, and it is expected that about 75 miles of roads will be built this season. Work will be commenced as soon as conditions permit. For the purposes of the by-law the township has been divided into four subdivisions, the amount to be expended being as follows: No. 1, \$43,000; No. 2 \$40,000; No. 3, \$27,000; No. 4, \$40,000.

Welland county, Ont., has voted \$175,000 for road work during the coming season—\$100,000 for the construction and \$75,000 for repairs. The council has agreed to build a mile of concrete roadway in Ridgeway township, as petitioned for. The road to be built is to be 16 ft. wide and the township has agreed to add another 14 ft. to the right of way, and is also to supply 1,000 yards of stone for the work. The undertaking is, of course, contingent upon the approval of the Department of Highways and their grant of 40 per cent. The road known as Dain Avenue is also to be constructed this year if the John Deere Co. contribute \$1,500 and the township of Humberstone \$2,500 towards the work.

Contracts for eight miles of good roads to cost \$60,000 and for seven bridges to cost \$7,000 have been let by the Toronto & York Highways Commission. The contract for the macadamizing of the three remaining miles of the road from Yonge Street to Unionville, has been awarded to R. Fisher, of Toronto, at \$24,000. A. J. Jupp, of Toronto, has the contract for building three miles of bituminous-bound macadam north on Yonge Street from Armitage to Holland Landing, at a cost of \$30,000. A macadam road will be extended two miles north of Woodbridge, the contract going to E. Dagg, Toronto, at approximately \$16,000. New bridges will be built at Schomberg, Oakridges and Vandorf, costing in all about \$7,000. They will be of concrete. R. Blackwell, of Peterboro, has the contract. The Commission has agreed to supply oil at cost-price to any municipality requesting it. Road scraping has already commenced, and in a few weeks gangs will repair the damage of the open winter.

At the meeting of the Associated Board of Trade of Ontario in Toronto, Hon. Finlay Macdarmid, Minister of Public Works and Highways, addressed the delegates, making reference to the provincial government's road policy, which he said would be pushed aggressively and without delay. It was proposed, he said, to carry out a most comprehensive programme this year and the years following until the whole province would be covered by a system of highways that would be second to none on the continent. He also made reference to the deputation which had petitioned for the construction of a highway from Toronto to Sarnia as well as from Hamilton to Windsor, as part of the transprovincial highway scheme. While the Minister did not commit himself to any definite statement as to what action would be taken, he showed himself more or less favorable to the proposal.

New Book

Trautwine—A civil engineer's hand book, published by the Trautwine Company, 257 South Fourth Street, Philadelphia, Pa. Price \$6.00 net. This is the twentieth edition, revised, enlarged and brought up to date. It contains 1,500 pages under the following section headings: Mathematics; Natural Phenomena; Mechanics, Force in Rigid Bodies; Strength of Materials; Hydrostatics; Hydraulics; Constructions, etc.; Water Supply; Test and Well Boring; Rock Drills; Traction, Animal Power; Trusses; Bridge Specifications; Suspension Bridges; Rivets and Riveting; Railroads; Materials; Concrete; Costs.

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The Versatility of Concrete

CONCRETE, whatever its defects may be and whatever criticism may be arraigned against it, can certainly lay claim to versatility. That a material of construction of such comparatively recent origin should have reached to its present stage of usefulness and reliability in so few years is nothing short of phenomenal, but it is none the less remarkable that this sphere of usefulness is constantly being enlarged and the scope of its reliability broadened, until concrete bids fair to become the construction material universal. The degree of confidence one may place in its performance has increased steadily as it has been demonstrated that it is capable of wide application and adaptability. Concrete has been for a long time now a factor to be reckoned with when any building design was promoted. For submarine structures for water-retaining reservoirs and dams, for load carrying piles, concrete has been demonstrated to have virtues of proven worth. But its merits cannot be confined to the three or four applications of major prominence; there are dozens of places where concrete

can lay claim to adaptability, performance, endurance, and permanence.

The war has brought a new field of usefulness to the fore—ship construction. While as yet we have no extensive service data upon which to gauge the value of concrete as a shipbuilding material, there is nevertheless sufficient evidence to allow ship designers to consider its possibilities along this line. Perhaps the war has been responsible for the development of concrete for ships to the extent that it has been developed and no doubt an even wider sphere of utility will now be demonstrated as actual data under service conditions are gathered.

Concrete's versatility, however, seemingly knows no bounds, for an announcement in the Contract Record of April 9th contains an outline of the most recent exploit in the realm of concrete construction—the application of concrete to the bodies of freight cars. This is surely an indication of the universal service of this material. From the news item referred to, we would judge that the first experiment with a concrete freight car demonstrates sufficient practicability and serviceability to make further tests valuable. Concrete freight cars will, of course, if they prove reliable, have important advantages that cannot be gainsaid. If this latest venture proves as satisfactory as the experiments would lead one to suppose, it certainly promises to be far-reaching.

Royal Commission to Investigate Labor Problem

IT was recommended last week by the Labor Committee of the Commission on Reconstruction and Development of the Privy Council, of which Senator Gideon Robertson is chairman, that a Royal Commission of seven persons be appointed at once to advise the government on the now all-important question of the relation of capital and labor. The object is to bring out ideas and suggestions which may make possible a permanent improvement in this relation, and to evolve means for the methodical review of conditions affecting the problem, in order that the improvement may be maintained and continuous progress made in the future.

The first step which, it is suggested, will be necessary for the commission to take will be to make a survey of our industries and classify them by groups for the purpose of introducing industrial co-operation. The extent of the organization now existing both in the ranks of the employees and among the employers will also be investigated, and the results already obtained by the establishment of joint industrial councils in Canada, Great Britain and the United States carefully studied.

While the varying conditions in the different industries make individual solutions necessary to many problems, it is felt that there are basic principles and universal difficulties which can be broadly considered and dealt with by such a commission. It is proposed that the final report of this commission be presented not later than May 15, 1919.

The latest report gives the personnel of the commission as follows: Chief Justice Mathers, chairman; Senator White and Charles Harrison, M. P., representing the public; Carl Riordon, president of the Riordon Pulp & Paper Company, Montreal, and T. Pauze, lumberman, Montreal, representing the employers;

Tom Moore, president of the Trades and Labor Congress of Canada, and J. W. Bruce, member of the Labor Appeal Board, Toronto, representing the employees; Thos. Bengough, Toronto, will be secretary of the commission.

A Creed of Industrial Relations

THE following clauses are taken from a creed advanced at the Reconstruction Congress, held in Atlantic City in December, and attended by over 5,000 delegates from all over the Continent:

1.—“Labor and capital are partners, not enemies; their interests are common interests, not opposed, and neither can attain the fullest measure of prosperity at the expense of the other but only in association with the other.

2.—“The purpose of industry is quite as much to advance social well-being as material well-being and in the pursuit of that purpose the interests of the community should be carefully considered, the well-being of the employees as respects living and working conditions should be carefully guarded, management should be adequately recognized, and capital should be justly compensated, and failure in any of these particulars means loss to all.

3.—“Every man is entitled to an opportunity to earn a living, to fair wages, to reasonable hours of work and proper working conditions, to a decent home, to the opportunity to play, to learn, to worship, and to love, as well as to toil, and the responsibility rests as heavily upon industry as upon government or society to see that these conditions and opportunities prevail.

4.—“Industry, efficiency, and initiative, wherever found, should be encouraged and adequately rewarded, and indolence, indifference, and restriction of production should be discountenanced.”

Programme of the Associated General Contractors of America

CONTRACTUAL relations are to be improved, sound business practices encouraged, and construction interests co-ordinated if the aims and tasks determined upon by the Associated General Contractors of America are accomplished. Action will be taken through committees supplied with information and data collected by the secretary and a force of clerical assistants and special investigators to be developed as the need arises.

The program of operations, as recently completed and approved by the directors of the association, is: (1) To promote better relations between owners and their architects and engineers on the one hand and contractors on the other hand; (2) to improve and maintain standards in the conduct of work; (3) to combat unfair practices; (4) to increase construction efficiency; (5) to support contractors and contractors' associations in efforts to rectify conditions of an unsatisfactory character; (6) to encourage those methods of contracting for work which relieve the contractor of improper risks; (7) to encourage sound business methods tending to raise the standing of contractors in the business world.

Besides the committees having charge of the rou-

tine work of the association, there are committees on contracts, legislation, labor, publicity and education, associated organizations, building codes, mutual aid, cost accounting, ethics, and safety. The committees named will conduct the professional work of the association. General directions of procedure have been formulated for each of the seven subjects of the program. Particular effort will be made to push the work and items 1 and 6 of the program.

Better relations between owners and contractors are to be established as follows, as the program states:

(1) By teaching owners that the association stands for high ideals and that membership guarantees the reputation of the contractor for skill, honesty and responsibility; (2) by securing a more universal adoption of the cost plus sliding scale fee contract, thereby making the contractor a representative or agent of the owner; (3) by persuading contractors that the interests of their clients and of the community are identical with their own, and that a satisfied client is an asset of immeasurable value; (4) by treating employees with justice and liberality and by taking an interest in their welfare. Specific measures recommended are: Reducing lost time of men, schooling foremen, encouraging apprenticeship, and reducing jurisdictional disputes.

Contractual relations will be improved by urging the adoption of the cost plus sliding scale fee contract where practicable; by insisting that full information be given when lump-sum bids are required; by compelling elimination of the usual clauses placing on the contractor all unforeseen risks and the clauses requiring the contractor to deliver a finished project regardless of what the architect or engineer forgot to specify or show, and by studying and possibly working out a practical arrangement for quantity surveys.

Toronto E. I. C. Appoints Three Committees

THE Executive Committee of the Toronto branch of the Engineering Institute of Canada has appointed three sub-committees. The first is to consider the ways and means of finding employment for disengaged engineers and for the advancement of others who are seeking the same. This committee had elected Mr. E. T. Wilkie as chairman and Mr. W. Cross as secretary. It is now vigorously organizing its investigation and hopes to present its report soon.

The second sub-committee was appointed to consider the feasibility of drafting a scale of fees for services rendered by engineers. This committee is presided over by Mr. Frank Barber and the secretary is Mr. W. S. Harvey. The committee consists of some of the leading men in the profession.

The third committee is considering the problem of grading the salaries of engineers according to their responsibilities and duties of office.

The Executive Committee consider it is due to the public and to the engineers that these matters should be put upon a satisfactory basis. It is well known that bureaus have been organized by the trade and labor unions and by the governments but these do not adequately provide for the needs of professional engineers. They also deem that the other subjects are equally important to the public because competent service merits reasonable remuneration.

Pretoria Avenue Lift Bridge, Ottawa

Two 52½ ft. Fixed Spans and a Central 95 ft. Electrically Operated Direct Lift Span Giving 30 ft. Maximum Clearance

By L. McLaren Hunter, A. M. Inst. C. E. and M. E.*

TO provide the eastern district of the city of Ottawa with a street car service a bridge had to be built over the Rideau Canal at Pretoria Ave. The cost of this structure, which has just been recently completed, was about \$125,000, divided equally between the Dominion government and the city of Ottawa.

Owing to the unsuitability of the approaches a high level bridge could not be constructed economically, so a direct lift bridge was decided on as the most suitable for the site. The bridge consists of a central 95 ft. lift span and two 52 ft. 6 in. stationary spans. The curved wing walls and the winding paths and roads forming the approaches to the bridge provide a very artistic setting for the structure. Fig. 1 shows with the lift span open to permit traffic under the bridge, and closed to allow traffic to proceed along the bridge.

Twelve-inch piling was driven in fifty foot lengths for the foundation of the piers and abutments. These piles were tested to 17 tons per pile. A 1:3:5 mixture was used for the abutments. The abutment walls are 7 feet wide at the base and 18 inches at the top. Above the waterline the abutments were faced with sandstone and this gives them a very pleasing appearance. The contract for the piers and abutments was carried out by Mr. R. Brewder of Ottawa.

The roadway is 44 feet wide and will carry a double street car track. The sidewalks on both sides are 6 feet wide. The side spans are of plate girder construction but the outer girders are encased in concrete, so that their appearance is that of concrete or masonry arches; they thus harmonize with the piers and retaining walls.

No Cables in Movable Span

The most interesting part of the structure is the movable span and this is particularly noteworthy, since it is of a type which has been developed recently but

which has, nevertheless, gained consideration from leading Canadian and United States engineers. This type of bridge is known as the Strauss direct lift bridge. In contrast to the bascule bridge which lifts by rotating around one end as the lid on a box, the direct lift bridge moves straight up and down like an elevator, but the Strauss direct lift bridge is distinguished from the elevator and from other lift bridges which have been built in former years, by the completed absence of cables or wire ropes. Such cables or wire ropes have been for many years the only means of bringing about a vertical movement and of connecting such a structure with the necessary counterweights, but experience has shown that these cables do not stand up where they are used out of doors and exposed to the action of the elements. This bridge represents a departure in this field, in that it comprises a system of levers for the cables and sheaves and in this way brings about both exact counterbalancing and the operation of the bridge through any height of lift. In this instance, the vertical movement of the lift span is 20 ft. so that when the bridge is fully open it affords a clear channel of about 80 ft. in width and of 30 ft. clearance. All mechanism, counterweights, etc., are entirely hidden under the roadway. The bridge is perfectly balanced in every position.

The bridge is operated by electrical motors, and it is possible to open or close it in less than a minute. The mechanical and electrical installation are fully up-to-date and includes all the latest and most modern control and safety devices.

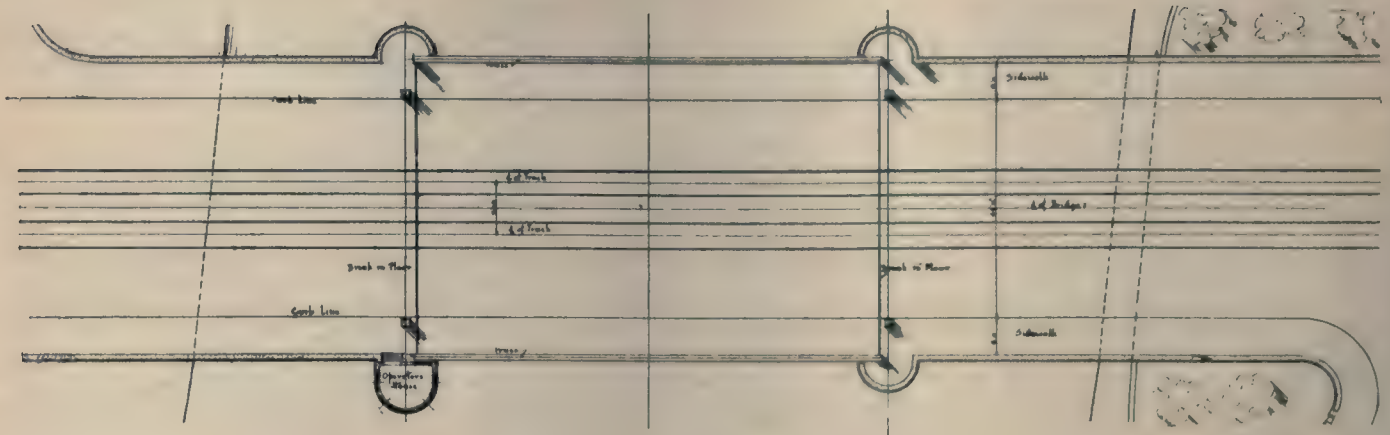
Automatic Chain Barriers

Among the latter are two so-called automatic chain barriers, one at each end of the bridge, which, when the bridge is closed, are concealed under the roadway, but which come into action when the bridge is to be raised. These barriers, which are controlled electrically from the operator's house, have some resemblance to a lawn

*City Engineer's Department, Ottawa.



The Pretoria Ave. lift bridge, Ottawa, closed and open



Deck plan of Pretoria Ave. lift bridge

tennis net stretched out over the roadway. The important feature of this particular gate or barrier is that, if stuck by a street car or a fast moving automobile, it will "give," that is, the chains which form the barrier will pay out under a gradual increasing resistance and the vehicle will, therefore, be brought to a gradual stop without injury. Early designs of safety gates for draw bridges and railway crossings were either so light that they formed no barrier at all and did not, therefore, prevent a fast moving machine or the like from going into the channel, or else they were made so strong and rigid that colliding with the gate would be about as dangerous as going into the river. Not until the chain barrier was invented has the problem been solved of a protection gate which really protects.

The operator's house is built on the protruding part of the northwest pier and is constructed of "bullnosed" sandstone to match the rest of the structure.

The roadway of the bridge is paved with creosoted wood blocks. These are laid on 2-in. creosoted planks, with 4-in. by 6-in. creosoted joists placed at 12 inch centres.

The approaches to the bridge were laid out and constructed by the city, the Ottawa Improvement Commission doing the ornamentation work of planting shrubbery and flowers.

The designing of the bridge was done by the

Strauss Bascule Bridge Co., consulting engineers, Chicago, U. S. A. The contract for the superstructure was carried out by the Dominion Bridge Company of Ottawa.

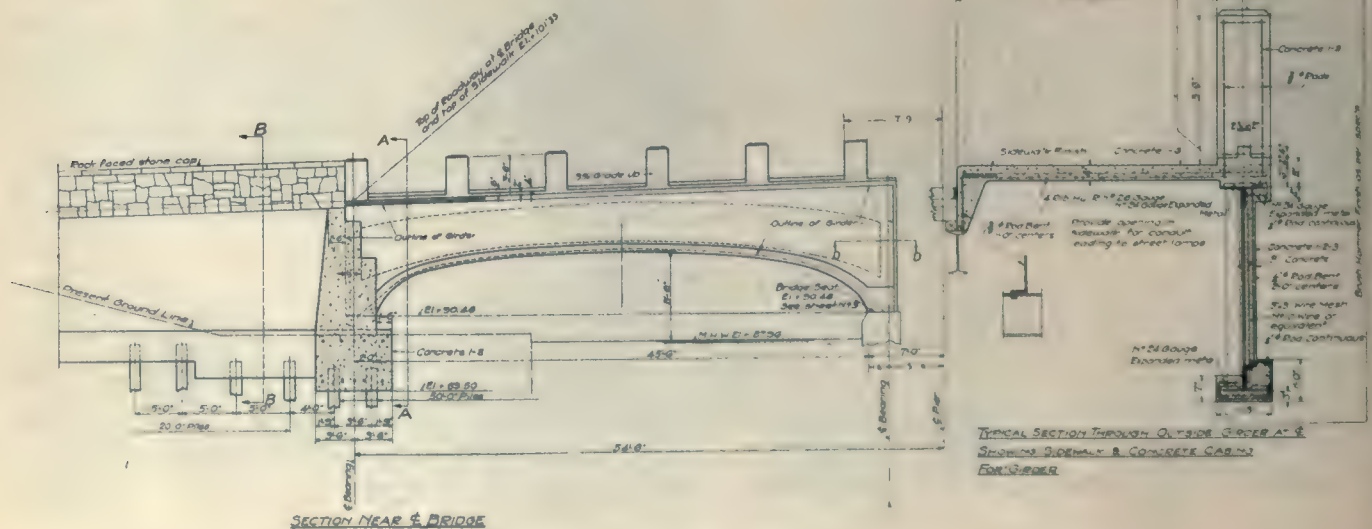
To Mr. Robt. Henham, the city's bridge engineer, must credit be given for the manner in which the construction details were carried out and especially the counterbalancing of the lift span which worked to perfection at the first trial.

Mr. F. C. Askwith was acting city engineer during most of the construction work and latterly Mr. Andrew F. Macallum, commissioner of works, had the general supervision of the work.

Quebec Divided into Districts

The Quebec Department of Roads is dividing the province into 21 districts with a view to greater supervision over the work of road construction and maintenance. Every district is to be under the jurisdiction of a resident engineer responsible to the chief engineer at Quebec.

Grant Hall, vice-president of the Canadian Pacific Railway Company, has confirmed the report that the company would spend more than \$5,000,000 on reconstruction work in the west.



Left: Section showing abutment and fixed span. Right: Section through outside girder

Toronto Industrial Council

Constitution and Personnel of First Joint
Building Trades Council in Canada
—Follows Whitley Plan

TO engender the spirit of co-operation between employers and employees and assist in solving some of the difficult problems confronting the industry a joint industrial council of the building trades has been formed in Toronto. The council consists of ten members and a chairman, whom the Toronto Chapter of the Ontario Association of Architects has been asked to select from its membership. The labor representatives are: John Doggett (for the carpenters), John Vick (bricklayers), W. Storey (plumbers), D. A. Webber (plasterers), W. Varley (laborers). The representatives appointed by the employers are: C. Blake Jackson, of the Jackson-Lewis Construction Co., and John V. Gray, general contractors, representing the Toronto Builders' Exchange, Frank Maxwell, for the Toronto Society of Domestic, Sanitary & Heating Engineers, Jas. Phinnemore, for the International Master Painters' Association, and George Kay (of the Bennett & Wright Co.) for the Toronto Section of the Ontario Association of Electrical Contractors & Dealers.

Below we print the draft of the proposed constitution which we understand has been agreed upon subject to any changes that may be found necessary as the work of the council proceeds. The plan follows pretty closely the well-known Whitley plan which has taken such a hold in England.

Proposed Constitution to Govern the Joint Industrial Council of the Toronto Building Trades

1. Name

This council will be known as the Joint Industrial Council of the Toronto Building Trades.

2. Aims and Object

To harmonize and standardize the conditions of contracting and employment in the Toronto building trades, and to secure the largest possible measure of joint action between employers and employees, for the development of industry as a part of national life and for the improvement of the conditions of all engaged in that industry.

3. Membership

The council shall consist of ten (10) members with power to add to their numbers. Representation shall be as follows:

- 2 from Builders' Exchange.
- 1 from Ontario Association of Electrical Contractors and Dealers.
- 1 from the Toronto Society, Domestic Sanitary and Heating Engineers.
- 1 from International Master Painters' Association.
- 5 from Building Trades League.

4. How Elected

Representatives shall be duly elected by their respective bodies (see clause three) and it is further provided that it shall be optional for both parties to elect alternatives.

5. Chairman and Vice-chairman

The chairman shall be a co-opt member; he shall be a disinterested person, and shall be elected by a

majority of the council. There shall also be two (2) vice-chairmen, one to be chosen by the employers and one by the employees.

6. Secretary-Treasurer

The council shall be empowered to maintain a secretary-treasurer and such other clerical staff as it may think fit.

7. Term of Office

The representatives to the council shall retire annually, and shall be eligible for re-appointment by their respective bodies. Casual vacancies shall be filled by the association concerned, which shall appoint a member to sit until the end of the current year.

8. Committees

The Joint Council may appoint committees from time to time, as may be deemed advisable, and such committees shall report back all matters referred to them for confirmation, unless otherwise determined by the Joint Council.

9. Co-Opt Members

The council shall have the power of appointing on committees, or allowing committees to co-opt, such persons of special knowledge, not being members of the council, as may serve the special purposes of the council.

(a) The two associations in the council shall be equally represented on all committees, (b) any appointed co-opt members shall serve in consultation capacity only.

10. Duty of Officers

(A) The chairman shall preside at all meetings of the Joint Industrial Council, and all committee meetings, and shall perform such other duties as are usual for such an officer, provided, however, he shall have no voting powers.

(B) The vice-chairmen shall, in order, perform the duties of the chairman, in the advent of his temporary disability, or his absence from meetings. They shall have voting powers by virtue of their membership in the Joint Industrial Council.

(C) The secretary-treasurer shall keep a record of the proceedings of all meetings of the Joint Council, receive all moneys, and render a correct statement of same, at each general meeting of the council. He shall perform such other duties as appertain to his office.

11. Meetings

(A) The meetings of the Joint Council shall be held as often as necessary.

(B) The regular meetings of the Joint Council will be held on the first (1st) Monday of each month at 2 P. M. in the office of the Dominion Government Fair Wages Officer, or such other place as may be determined by the Joint Council from time to time.

(C) A special meeting of the Joint Council shall be called by the chairman within two (2) days of the receipt of a requisition from any of the constituent associations. The matter or matters to be discussed at such meetings, shall be stated upon the notice, calling the meetings.

12. Voting

The voting both in council and in committees shall be by show of hands or otherwise, as council may determine. No resolution shall be regarded as carried

unless it has been approved by a majority of those present on each side of the council.

13. Quorum

The quorum shall be three (3) members of each side of the council.

14. Finance

The expenses of the council shall be met by the Employers' Association and the Building Trades League, in equal proportion.

15. How Amended

This constitution may be amended by a majority vote of all the duly elected employee representatives together with a majority vote of all the employer representatives. Amendments must be proposed in writing at a regular meeting, and no vote shall be taken

thereon until the regular meeting following such presentation. No amendment shall be adopted that will destroy or limit the equal voting power of the employee representative and employer representative in the Joint Council.

16. Order of Business

- (1) Roll call.
- (2) Reading of the minutes of the preceding meeting.
- (3) Business arising out of the minutes.
- (4) Secretary-treasurer's report.
- (5) Communications and accounts.
- (6) Deferred or unfinished business.
- (7) New business.
- (8) Good of the council.
- (9) Adjournment.

Sewage System for Essex Border Cities

Intercepting Sewer with Regulating Chambers and Measuring Devices Form Initial Portion of Comprehensive Installation

IN recent years the cities located on the boundary waters of the United States and Canada have had to face the possibility of providing a method of treatment for their sewage before its discharge into the rivers or lakes. Extensive investigations by the International Joint Waterways Commission have pointed out the necessity and urgency of this, if the boundary waters are to be free from unsanitary and objectionable conditions and the purity of the waters is to be maintained. Although the results of the Joint Commission's investigations have been published, no decision has been promulgated, but if, as seems likely, standards of maximum pollution are established, it will be necessary for nearly all the municipalities on the boundary waters to treat their sewage before it enters these waters.

The Essex Border Utilities Commission, representing Windsor, Walkerville, Ford City, Ojibway, Sandwich and Sandwich West, a group of municipalities on the Canadian side of the Detroit River have latterly given serious consideration to the improvement of their water-front facilities and to the matter of sewage disposal and purification as a means to this end. The improvement of the waterfront of many a city is largely dependent on the improvement of the sewerage system and the Essex Border municipalities have recognized the fact that where nuisances do not yet exist from the discharge of raw sewage into the adjacent waters, foresight requires that sanitary sewer systems be designed with a view to ultimate interception to remove offensive material from the waterfronts.

The Essex Border Utilities Commission engaged Morris Knowles and John M. Rice to study the situation in the municipalities along the Detroit River, and to recommend methods of alleviating the nuisances likely to develop from the promiscuous discharge of sewage into the river without treatment. The engineers determined that all four kinds of nuisance resulting from excessive sewage pollution—flotation, deposition, putrefaction and infection—are found in the Detroit River, but their report stated that they could all be abated without difficulty at a relatively

small cost. With regard to the extent of the nuisances, the report stated:

Flotation Minimized by Extending Sewer Outlets

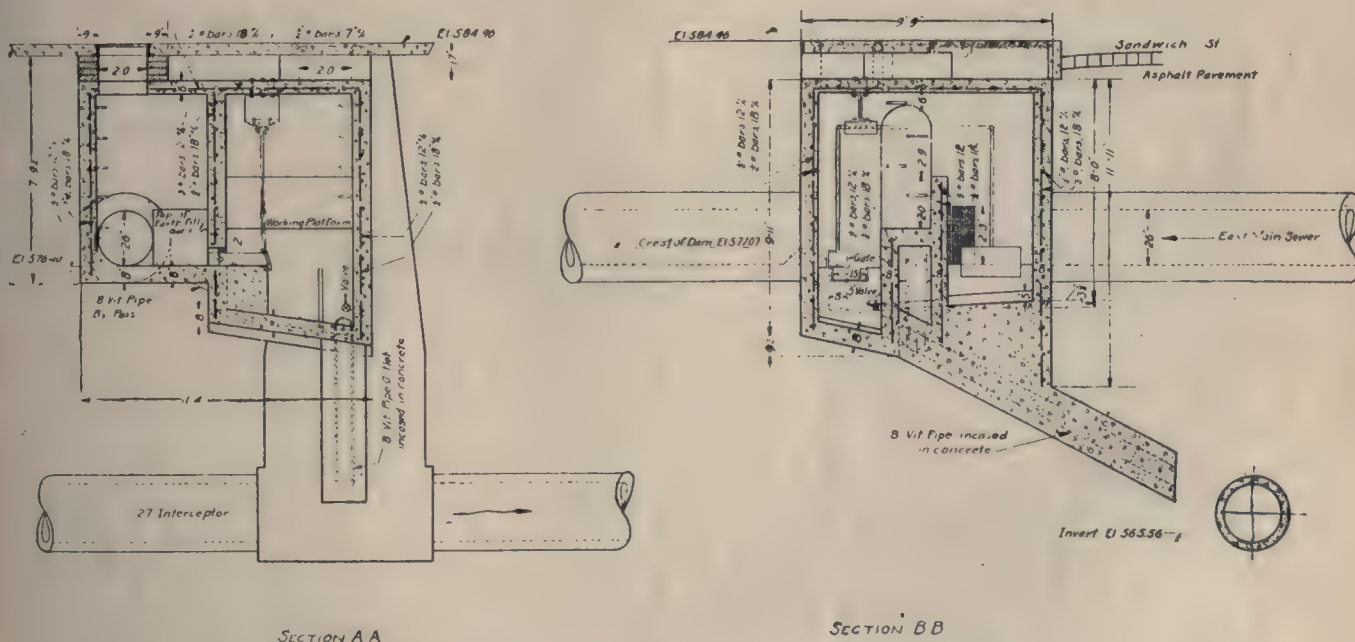
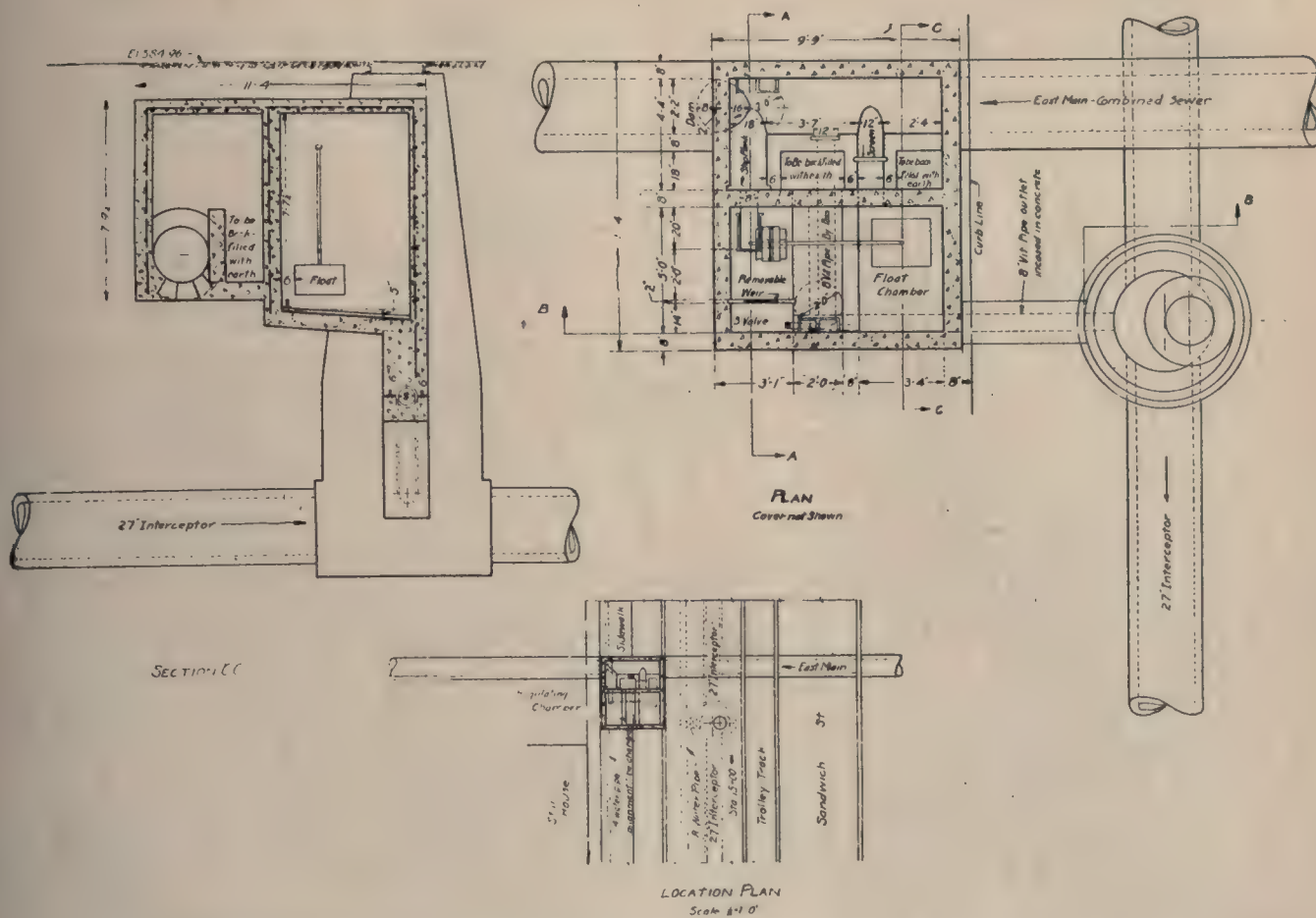
With the sewage of all cities and towns on both sides of the Detroit River now being discharged into that stream without treatment, floating solids appear in the neighborhood of sewer outfalls, discharging at or above the surface of the river, and at the bathing beaches. Large floating solids, such as might be removed by coarse screening, would, of course, be intolerable on a river so largely used by ferries and excursion boats. There is little pleasure boating in small boats on the river, on account of the swift current and large commercial traffic, but the use of the bathing beaches at Bois Blanc, about sixteen miles below Windsor, makes the appearance of any floating material objectionable. This nuisance may be minimized by extending sewer outlets to the bottom of the river in mid channel, where the depth is about 40 feet, and settling or medium to fine screening, to reduce this possibility still further, may reasonably be required at some future time.

Velocity Ample to Prevent Deposition

The velocity of the Detroit River is normally about three to four feet per second, amply sufficient to prevent the deposition of solid particles in the river bed, even though the amount of sewage be enormously greater than it is ever likely to be. No provision is, therefore, necessary to avoid this nuisance. The velocity of the river is occasionally decreased and may even disappear when continued winds pile up the water of Lake Erie at its western end. This, however, never lasts more than a few hours.

Putrefaction Not Likely to Occur

The discharge of the Detroit River varies between 190,000 and 220,000 cubic feet per second, with an average of about 200,000 cubic feet per second. The total population discharging sewage into the river on both the American and Canadian sides is now about 872,000, and the most liberal assumption regarding growth cannot justify the prediction of a larger popu-



lation than 1,350,000 in 1930. The average flow of the river, therefore, is 243 cubic feet per second per 1,000 of population now discharging sewage into the river, and 157 cubic feet per second per 1,000 of maximum possible population in 1930. When these figures are compared with the seven cubic feet per second per 1,000 of population, upon which authorities seem reasonably well agreed as the upper limit beyond which nuisance, due to putrefaction, will probably never occur, a margin of safety so large is indicated that it is apparent that oxidation treatment of any kind cannot be reasonably required at any time in the near future. All that is necessary in order to secure the advantage of the ample dilution afforded by the river is to discharge the sewage into deep water in the channel, probably with provision through multiple outlets for thorough dispersion and mixing.

Infection the Most Serious Trouble

"The most serious nuisance caused by the discharge of sewage into the Detroit River from the Essex Border district is undoubtedly due to the possibility of the pathogenic bacteria in the sewage, causing infection by entering the water supplies of the district municipalities and of those located on the river below the district; or causing infection to bathers and others who may drink the water in its raw state without purification.

"The Detroit River, forming one of the boundaries between Canada and the United States, is under the jurisdiction of an International Joint Commission. This Commission has conducted a very complete investigation of the Detroit River, the Niagara River, and other boundary waters, for the purpose of determining whether the treaty obligations of the two nations with reference to the protection of the purity of boundary waters are being observed. The conclusions of the engineer of the International Joint Commission were that the sewage of Detroit might sometimes cross the boundary line and endanger the water supplies of the communities on the Canadian side. It is not apparent from their report that they believe the sewage from the Canadian side would cross to the American side, and with the much smaller quantity of sewage delivered to the river from the border municipalities, and the direction and force of the main current of the river, this does not seem likely to occur in the near future. The time may come, however, when a much larger amount of sewage will be delivered to the river, causing a degree of pollution sufficient to justify the International Joint Commission in demanding that the burden placed upon the river be decreased by treatment of the sewage prior to its discharge.

Interceptor and Settling Tanks Recommended

It is concluded that the best method of abating the nuisances, due to flotation, deposition, putrefaction and infection from the sewage of the Essex Border municipalities is the collection of the sewage in an interceptor and its delivery to one or more centrally located points where additional treatment may be applied under proper supervision. The works to accomplish this result are planned to consist ultimately of interceptors, two-storey settling tanks, disinfection plants, detention basins, and multiple deep-dispersion outlets. Designs should be worked out for this ultimate development, and all new sewerage construction made to conform to these designs; and all of the proposed works, excepting the settling tanks, should be

built as soon as the financial condition of the community will permit. The construction of the sedimentation works, however, should be deferred until the general policy for the control of the river, as a whole, has been formulated, at which time much more information will no doubt be available regarding the process of activated sludge, and regarding the comparative advantages and economy of this process, fine-screening and two-storey tank treatment.

This report was accepted by the Essex Border Utilities Commission, and the first portion of the intercepting sewer was authorized to be built by an overwhelming vote of the people and contracts for half of the work were let last year.

East Interceptor

The east sewage interceptor, the work on which is being carried out, serves the municipalities of Ford City, Walkerville and Windsor to Parent Avenue in Windsor. The sewage flows by gravity through Ford City and Walkerville to a pumping station, whence it is lifted to a high level interceptor, through which it flows by gravity to Parent Avenue.

As Ford City had no existing sewerage system it was concluded that it would be sewered on the separate system. Walkerville and Windsor were well provided with a sewerage lay-out on the combined plan. The east interceptor was, therefore, planned to meet these conditions. A storm-water allowance for Walkerville and Windsor takes care of the first street washing, thus reducing pollution of the river-front waters.

Regulating chambers were provided at points where the outlet sewers of Walkerville cross the east interceptor. These chambers divert the dry-weather flow, plus the storm water allowance into the interceptor.

Measuring chambers, to determine the actual sewage flow from the several municipalities, are provided for at the dividing lines between Ford City and Walkerville and Walkerville and Windsor. The intercepting sewers were designed to serve the estimated (1950) population of the several municipalities.

Factors Governing Design

The factors taken into consideration to obtain the maximum flow for the several municipalities were the following:

- (1) Water consumption—(domestic use, industrial use, public use).
- (2) Ground-water leakage.
- (3) Storm-water allowance.
- (4) Economic considerations.

Factor No. 3 was only considered for Walkerville and Windsor, which have a combined system of sewers. To provide for contingencies which may arise and increase the sewage flow, and to avoid future expensive additional construction, it was considered desirable to allow a liberal margin of safety over the present flow per capita. This is based upon the fact that capacity increases at a rate greater than the square of the diameter, whereas cost increases at a much less rate. It was considered that the ratio of maximum to average flow would vary for various structures. A ratio of about 2.5 was used for small sewers, and this was decreased gradually to about 1.75 for interceptors.

It was concluded that 90 per cent. of the domestic water consumption, 85 per cent. of the industrial use

and 50 per cent. of the public use would be returned as sewage flow.

Infiltration

The leakage or ground-water infiltration through joints was taken as 15,000 imperial gallons per day per mile of pipe in clay soil, and 25,000 imperial gallons in sandy soil, which, on a basis of 1.25 miles of sewer per 1,000 population, gave 31 imperial gallons per capita per day for sandy soil, and 19 imperial gallons per capita per day for clay soil.

The storm-water allowance to apply only to Walkerville and Windsor was taken as 80 imperial gallons

tion and assumed quantities for the several Essex border municipalities served by the east interceptor:

Municipality	Estimated Population (1950)	Max. Rate Assumed in Design of Interceptor (Imp. gal. per capita per day.)
Ford.. . . .	15,000	250
Walkerville.. . . .	11,000	350
Windsor (East. portion)	14,000	350

The maximum rate of 350 imperial gallons per capita per day for Walkerville and Windsor include the storm-water allowance of 80 imperial gallons per capita per day.

The function of a regulating chamber is to divert

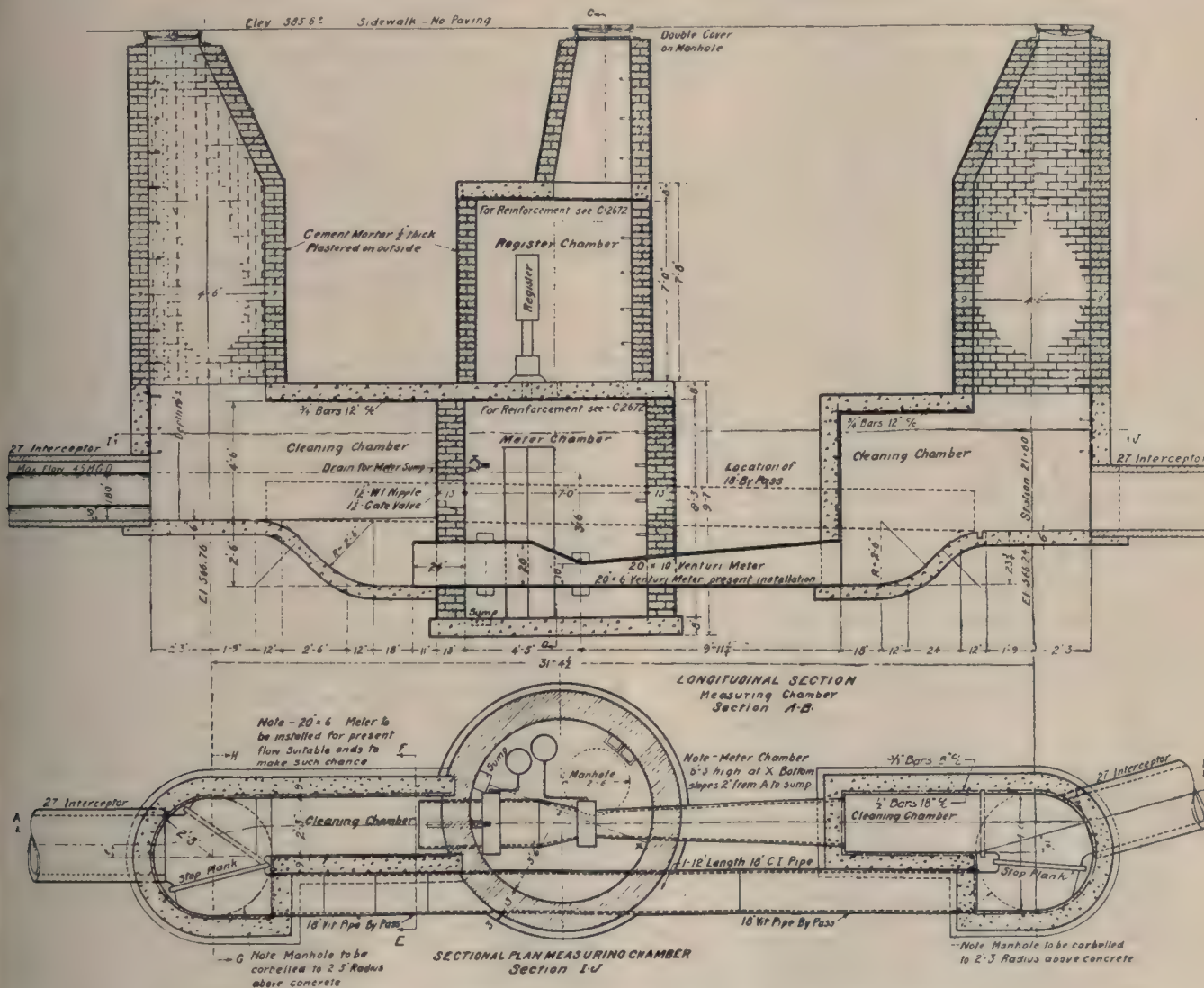


Fig. 3—Plan and section of Ford City measuring chamber, east sewage interceptor

per capita per day, equivalent to .005 inches of rain-fall run-off per hour.

The ratio of depth of flow to diameter of sewer was taken as not over .50 for all sizes up to 24 in. and not over .80 for sizes 24 in. and over. The minimum velocity for maximum flow was taken as 2.00 feet per second in the Ford City section, and 2.50 feet per second in the Walkerville and Windsor sections.

The following table gives estimated future popula-

the dry-weather flow and the first wash of the rain from the combined sewers to the intercepting sewers.

A considerable amount of study was devoted to determine the best suitable type of regulator to be adopted. Many studies were prepared with different types of mechanical apparatus, and finally the choice of regulator was made from three designs that had met successfully all important objections to other types.

Figs. 1 and 2 illustrate the design of the regula-

tor for the east main sewer, and show in detail the main features of the type of regulator adopted. The regulator consists of a float in a float chamber directly connected to the intercepted sewer. Two perpendicular bars and one horizontal bar from the connection between the float and a float-operated gate in a gate chamber at the end of an opening designed to take the dry weather flow plus the storm water allowance.

The float being directly connected with the intercepted sewer, as shown in section B-B, Fig 2, is actuated by the elevation of sewage in the sewer, and thus opens and closes the gate to discharge the desired quantity through the gate area. The ranges in the rise of float and gate were calculated and the point of support, which is adjustable, for the horizontal bar was determined to accommodate these changes.

A screen is provided between the float-chamber and the sewer to avoid deposits in the chamber. A 3 in. pipe drain, with a valve at the lower end, connects the float-chamber to the gate-chamber to permit drainage of the float chamber.

The sewage flows through the gate and before it goes to the interceptor it passes through a removable weir at the lower end of the gate chamber and thence through an outlet to a man-hole and interceptor.

A stop plank at the gate entrance and a by-pass outlet are provided in case the apparatus has to be cleaned, removed or repaired.

A dam of sufficient height at the lower end of the intercepted sewer in the chamber diverts the dry weather flow into the regulating chamber.

Economy of construction, simplicity of arrangement, desirability of continuity of operation, and the fact that this type does not depend on an orifice for its successful operation, dictated its choice. This type has the added advantage that the gate is regulated by one float which is directly connected to the sewer to be intercepted.

Measuring Chambers

A system by which sewage flow could be measured accurately was necessary, not only to properly apportion annual charges to the several municipalities, but also to fix the responsibility in case of future overcharging of sewers and consequent need of further extensions.

It was considered more satisfactory to measure the sewage where the interceptor crosses the municipal boundaries rather than to attempt to measure the flow from each inlet to interceptor.

A reduced number of meters was advantageous because meters would require constant attention to keep in condition and give reliable data, and the reduction in number would allow use of more expensive and accurate measuring apparatus. From the standpoint of accuracy and economical considerations Venturi meters were considered as giving the most satisfactory results. Venturi meters eliminate most of the objection of loss of head, which in case of weirs would be rather serious, as each drop at a weir would entail deepening the entire length of sewer below the weir.

Fig. 3 shows in detail the arrangement of the Ford City sewage-measuring chamber. In the design of this chamber provision was made for change in meter from a 20 in. x 6 in. to a 20 in. x 10 in. meter.

The Ford City measuring-chamber is located at a point where the interceptor crosses the municipal boundary between Ford City and Walkerville. It consists of a cleaning-chamber through which the sewage

flows before it enters the Venturi tube, which is located in a circular brick chamber, above which are a register chamber and manhole. After the sewage flows through the meter it passes through a cleaning chamber and manhole to the other end of the interceptor.

A by-pass pipe is located along the chamber to divert the flow directly into the lower cleaning chamber. Stop planks are provided at both ends to operate the by-pass pipe.

The Walkerville measuring chamber is located at the lower end of the west main pumping station about 900 feet east of the municipal boundary between Walkerville and Windsor. It consists of a circular brick chamber covered with a concrete slab and manhole above.

Cost Plus Fee on a Sliding Scale

When the engineers' estimate was made, the unit prices used were those based on prices obtaining in December, 1916, plus a liberal allowance for contingencies. The total estimated cost was \$95,200 excluding pumping station and appurtenances. When bids were called on a unit-price basis, the unprecedented cost of labor and materials resulted in the reception of very high bids, the lowest bid being \$163,600. These were rejected and new ones called for, on an entirely new basis.

By this new plan the Commission agreed to pay the amount estimated by the lowest reliable bidder on a unit-price bid plus a fee of \$12,000, which will be increased by twenty-five per cent of the saving over the estimated cost and decreased by ten per cent of any amount that the work costs more than the agreed estimate.

Bids were closed on August 22, 1918, and the contract awarded on an estimated cost by the low bidder of \$108,600, not including the fee. Merlo, Merlo & Ray were the successful tenderers.

Segmental Block For Larger Sizes

Estimates were made on the different kinds of material used for sewer work and it was found more economical to use a vitrified segmental block for the larger sizes and a vitrified sewer pipe for the smaller sizes. From Parent avenue, Windsor, to the relief main sewer near Walker road in Walkerville the segmental block, furnished by the Toronto Pottery Company of Toronto, is being used for the pipe which is circular and 33 inches in diameter. From Walker road to Drouillard road the intercepting sewer is 30 inches in diameter built out of the same segmental block. Easterly from Drouillard road, as the amount of sewage to be taken care of grows less, 24, 20, 18 and 15-in. vitrified sewer pipe is being used. It is furnished by the Ontario Sewer Pipe Company at Mimico, Ont., and the Hamilton & Toronto Sewer Pipe Company at Hamilton, Ont.

The shaft and tunnel method of construction is being used with good success. During October, ten shafts were dug and the tunnel excavated. The laying of the segmental block pipe followed closely the opening up of the tunnel so that there was no danger of the material caving in. Material has consisted of a stiff yellow clay which stands up very well and requires very little bracing. The lower portion of the tunnel enters the blue knifing clay which offers the best opportunity for rapid and economical sewer work in this section.

Sprinkler Devices for Building Protection

Operation and Limitations of Present Day Equipment—Frequent Inspection or Central Station Control Advisable

By F. C. Broadfoot*

THE earliest type of sprinkler protection was the perforated pipe system, in which the piping was placed close to the ceiling. Small holes were placed from 3 inches to 9 inches apart on the upper surface of the pipe in such a manner that the water was discharged toward the ceiling at an angle which would wet the ceiling to advantage, as well as properly cover the floor below. The arrangement of the holes was modified from time to time but in all the different systems the same trouble was encountered—corrosion of the holes. Galvanized sheet metal piping was tried but was a failure. A device came out a little later in the form of a non-corrosive orifice consisting of a thin plate which was placed over the outlet. This was improved upon by drilling the holes large enough so that brass bushings, with orifices of the proper size could be inserted. Then came the rose sprinklers which were attached to the pipes instead of placing them in the perforations. These consisted of perforated brass caps similar to watering can nozzles, and were placed about ten feet apart in much the same way as modern sprinklers.

Valve Control Unsatisfactory

In these different systems the general scheme for piping was the same. Starting at one end of the room it was run in parallel lines ten feet or less apart, beginning with $\frac{3}{4}$ -in. pipe and gradually enlarging so that the distribution from all holes or nozzles would be equal. These lines connected with the feed pipe which in turn was enlarged until a riser, or upright pipe feeding the entire floor was reached. Each floor had a separate riser with a controlling valve which was normally kept closed, only being opened manually when a fire was discovered. The location of these valves, therefore, was a very important feature and the fact that control valves were not readily accessible has been the cause of many failures. Another undesirable feature of a system of this kind is that water was not concentrated where needed but would wet down the entire floor, irrespective of the extent of the fire. This, of course, caused heavy water damage, and wasted water in locations where no fire existed. Heavy water damage was also caused by leaky valves or by the opening of the control valve through error, but probably the most unsatisfactory feature of all was the fact that the system was not automatic. In many of the fires that occurred in the mills so equipped, the valves were either forgotten or were not opened soon enough, so that the equipment failed to control the fire.

Automatic Control

These failures enforced the necessity for the invention of automatic control, and we find that the first automatic device on record was patented in England in the 17th century. It consisted of a cask of fire extinguishing liquid containing a pewter chamber of gunpowder. This was connected with a system of fuses which ignited, exploding the gunpowder and scattering the solution. In 1809 another English inventor patented rose sprinklers which were controlled by com-

bustible cords. The cords were soon replaced by fusible cement and later by fusible wire, but in all systems up to about the middle of the 19th century the fusible parts were in connection with the control valve on the riser.

In 1864 we find the invention by Major Harrison, of the First Engineer London Volunteers, of an automatic sprinkler head as well as a complete sprinkler system, with all the essential features of a modern installation. This system was not put on the market and Henry Parmelee, of New Haven, is given the credit for inventing the first automatic sprinkler head to be used extensively. His invention came out in 1874, and in the following ten years many heads of widely different types were thoroughly tested. The more important of these types were: Heads depending on the burning of cords; rose sprinklers with sealed caps; rose sprinklers with valves inside; sealed type with turbine or slot distribution; and valve sprinklers, with deflectors and operating by the fusing of solder. The last type is the only one that has stood the battle and since about 1885 there has been much development in this type of head, to the exclusion of all other types. According to patent records in the United States alone, 450 patents have been taken out since 1872; yet there are only a dozen or so heads on the approved list and only five or six extensively used.

Wet and Dry Pipe Systems

In the ordinary type of sprinkler equipment of today water is maintained in the pipes under pressure. An equipment of this kind is known as a Wet Pipe system, but can be installed only in heated buildings. Where buildings are not sufficiently heated to prevent freezing in winter the Dry Pipe system must be used. This system is one in which there is air under pressure, instead of water, in the pipes.

Acceptable water supplies may be furnished by public water works, gravity tanks, air-pressure tanks or automatic pumps. Two independent supplies are absolutely essential for the best equipment. This is in order that one supply may always be available in case the other is temporarily out of service, and also in order that a primary supply of limited capacity or light pressure may be reinforced by a secondary supply. At least one of the supplies must be capable of furnishing water under heavy pressure.

The public water works system should be sufficient to give good pressure at all hours to the highest line of sprinklers, preferably not less than 25 lbs. when sprinklers are open and fire streams are playing. No water supply for sprinklers should pass through a meter or pressure regulating valve, as such devices cut down the flow of water. They are also unreliable and beyond the control of the assured.

Tanks Must Give Sufficient Pressure

If gravity tanks are used they should be so placed that the bottom of tank is not less than 25 feet above the highest line of sprinklers supplied. If pressure tanks are used, they should be located either on the top floor of the building or preferably on the roof. The tank must be kept two-thirds full of water and an air-

*Engineer, Mainland Fire Underwriters' Association of B.C.

pressure maintained over the water of not less than 75 lbs. so as to insure not less than 15 lbs. pressure at the highest line of heads, when all the water has been discharged from the tank.

Fire pumps may be operated by steam or electricity, but the suction must be from an approved source and the entire installation must be in accord with Underwriters' rules and requirements.

Whatever the water supply may be there should also be a connection at the sidewalk, which will permit of the direct attachment of fire engines. This is known as the Siamese engine connection.

All equipments must be provided with control, check and drain valves, all of which must be carefully located. The supplies should be so gated that they will be readily controlled, and check valves should be placed so that when water has entered the system from any one source it will be impossible to escape through connections with other sources. Drain valves must be installed at each alarm or dry valve, in front of each floor control valve, and at all low points in the system.

Automatic Alarms

In standard equipment there must also be an automatic alarm. In a wet pipe system this consists of a device which is installed in the main sprinkler riser and is arranged to actuate some form of alarm as soon as water flows through the system. These alarms are of two types: rotary gongs, operated like water wheels, by the passage of water through them, and electric gongs, operated by the movement of a check valve or by the closing of an electric circuit through the action of water pressure on a diaphragm. Alarm valves are valuable for two reasons—they give an alarm when sprinklers open on account of fire, thus acting as a fire alarm, and they give warning in case of flow through the system from other causes such as a broken pipe, opening sprinkler head, etc.

There are two principal types of alarm valves that have been successfully used. In one a check valve is placed in the main water pipe and the movement of the clapper when water begins to flow, transmitted usually through a packed stem, is used to actuate the alarm. In the other type a check valve is also used and this, when in its normal position, closes an outlet to a small pipe running to the alarm devices. This is accomplished by having the small pipe run from a groove in the valve seat, a horn in the water way or an auxiliary valve outside the main water way. Valves of the former type were used in the early days but few are now found in the field.

Joints Tight in Dry-Pipe System

A dry-pipe system is installed in a manner similar to wet-pipe system except that more care is necessary in arranging all parts to drain properly and, on account of the increased difficulty of holding air under pressure, extra precaution should be taken to make all joints as tight as possible. A dry valve is installed, usually inside the building at the lowest level, and when the system is in normal condition there is no water in the pipes above this point.

This valve is a device for holding back the water in a sprinkler system until a fire occurs when it opens automatically, allowing the water to flow into the pipes. Air is pumped into the pipes above the dry valve and the pressure thus created holds the valve closed. These valves are always designed so that a moderate amount of air pressure will hold back a much heavier water pressure. This is done for two reasons:

first, because a heavy air pressure is difficult to pump up and hard to maintain; second, because the time necessary to exhaust a heavy air pressure and the faning effect on the fire of the escaping air both act against the quick control of a fire.

Several different types of dry valves have been invented, but those in use to-day are of two types, the differential and the mechanical. In the differential type there is a double-seated check valve, the upper or air seat being much larger than the lower or water seat. The difference in area between these two seats determines the differential or difference in pressure necessary to balance the valve. Valves of this type are generally designed with a differential of about 7 to 1, that is, one pound of air pressure on the upper side will just hold the valve closed against seven pounds water pressure on the lower side.

Limited to 400 Heads

In the mechanical type the check on the water side is held closed by a system of levers, these being held in place by the action of air pressure in the pipes. Here there is generally no fixed ratio of air and water pressure that will hold the valve closed but the valve is designed to open at a predetermined air pressure which, however, can be somewhat varied by the amount of pressure exerted on the adjusting screw.

Dry-pipe systems are limited in size to 300 or 400 heads for the reason that the larger the system, the larger the amount of air to be exhausted and, therefore, the longer the delay in water reaching the head which has operated.

As automatic sprinkler protection is based on the principle of discovery and controlling a fire at its origin, thus insuring minimum loss with a minimum use of water, we must have thorough protection in all areas, quick and positive action of the heads and an adequate supply of water under sufficient pressure. The system must be thoroughly inspected at regular intervals, maintained efficiently and be under constant supervision of some employee who is familiar with its operation and repair, or it must be under central station supervision.

Fire records show that the value of sprinkler protection is entirely dependent upon effective maintenance, as the greatest losses have been due to the system being inoperative at the critical moment. Twenty-seven per cent of the sprinkler failures have been due to closed valves, 25 per cent to unsprinklered portions and defective heads, 10 per cent to defective water supplies, 5 per cent to faulty building construction, 6 per cent to obstructions to sprinklers, and the remaining 25 per cent to exposures, conflagration, explosions, and hazards due to occupancies too severe for the average sprinkler equipment, etc.

Frequent Inspection Essential

This list shows plainly the points which require particular attention, both in the maintenance and inspection of the sprinkler equipment. Regular inspections, preferably at weekly intervals, of all the vital parts should be made by the property owner, and insurance inspectors make their rounds three or four times a year. A device may remain out of order for three or four months if the assured were to depend upon supervision by the insurance companies, and it could be out of commission for the greater part of a week if depending upon weekly inspection by the property owner. This difficulty is overcome to a large extent by having the watchman make rounds of the en-

tire equipment each night or by having the central station supervisory service. In this service electrical devices are attached to every vital part of the system and whenever abnormal conditions are indicated signals are transmitted to the central station and the trouble is immediately investigated.

Amendments to Lien Act

Proposed Changes in Ontario Lien Law Not
Considered in View of New Bill Being
Brought in Next Session

DURING the present session of the Ontario Legislature, Mr. Joseph Russell, M. P. P. for East Toronto, who is a member of the Toronto Builders' Exchange, introduced a bill, entitled "An Act to Amend the Mechanics' and Wage Earners' Lien Act." This bill did not pass the committee stage, as, owing to the fact that the original Lien Act has been amended and changed so often as to be scarcely recognizable, it was considered advisable to leave the matter over till the next session and bring in an entirely new bill. Accordingly, on the suggestion of Hon. T. W. McGarry, provincial treasurer, a commission is to be appointed at the present session which will deal with the question in the interval and will meet with representatives of the Provincial Builders' and Supply Association, the architects, the labor organizations and the loan companies, in order that a measure that will be mutually satisfactory may be drawn up.

It now looks as if we have an opportunity to fix up this very contentious law once and for all. It is important, however, that during the intervening months the viewpoint of every corner of the province should be heard. With this in mind we invite discussions on the present Lien Law and suggestions as to the final form it should take. Mr. W. E. Dillon, past-president of the Toronto Builders' Exchange, and Mr. H. Elgie, president of the Provincial Builders' & Supply Association, have been particularly active in connection with the present Act and would also be glad to receive communications from contractors or other interested parties.

It may seem at first sight that there is no need for haste in this matter, but let us not forget that it is a question about which there are many and varied opinions and it will take some time to correlate all of the contending interests into one harmonious, workable Act. Prompt action is urged, therefore, so that the work of the government commission and of the interested representatives may be pushed forward with all possible speed to a successful issue.

As a basis of discussion we reprint below the draft of the amendment proposed in the bill introduced by Mr. Russell:

AN ACT TO AMEND THE MECHANICS' AND WAGE EARNERS' LIEN ACT

His Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

1. Subsection c of Section 2 of The Mechanics' and Wage Earners' Lien Act, is hereby amended by striking out all the words after the word "Furnished" in the sixth line thereof, down to and including the tenth line thereof and substituting therefor the follow-

ing words, "with whose knowledge by himself or his agent."

2. Section 6 of the said Act as amended is further amended by adding thereto after the word "of," in the fourth line thereof, the words, "or who actually manufactures."

3. Subsection 1 of section 12 of the said Act is amended by striking out the word "twenty" in the seventh line thereof, and substituting the words "thirty-three and one-third."

4. Subsection 2 of section 12 of the said Act is repealed and the following substituted therefor:

"(2) Where it is established to the satisfaction of the judge or other officer trying the action that the owner, by himself or his agent, knew or ought to have known that the contract price was inadequate, the amount to be deducted under the preceding subsection and in the respect of which the person primarily liable shall be liable to the lien holders, shall be calculated upon the actual value of the work, service or materials actually performed or furnished."

5. Subsection 4 of section 12 of the said Act is amended by striking out the words and figures thereof up to and including \$15,000.00, in the third line thereof, and substituting therefor the following:

"all payments up to sixty-six and two-thirds per cent."

6. Subsection 1 of section 14 of the said Act is repealed and the following substituted therefor:

"1. The lien shall have priority over all judgments, executions, assignments, attachments, garnishments, or receiving orders, recovered, issued or made, and over all payments made on or on account of any mortgage or conveyance, after the commencement of the work or service, or after the first materials were placed or furnished."

7. Section 14 of the said Act is amended by adding thereto the following subsections:

"(2a) Where there is an agreement for the purchase of land and the purchase money or part thereof remains unpaid, any lien-claimant may require that an enquiry be had and a finding made in the action as to the true value of the lands affected by the said agreement at the time of the sale thereof and as to the amount unpaid on such true value as so found at the date of the attachment of the first lien; and the seller shall not be deemed a mortgagee for any sum in excess of the amount so found to be remaining unpaid upon such true value.

(2b) Where there is an agreement for the purchase of land under which the purchaser is required to erect or construct any building upon the land therein referred to, the seller shall, for the purposes of this Act, be deemed an owner as defined in section 2 of this Act.

(2c) Where the property in respect of any interest in which a right of lien exists is subject to an agreement for sale, or is under lease, and the purchaser's or lessee's rights in respect thereto are abandoned or forfeited, any lien holder on written notice to the vendor or lessor, within thirty days after the lien holder shall have received actual notice of such abandonment or forfeiture, may become subrogated to the rights of such purchaser or lessee without prejudice to his rights under subsection 2a of this section and the person so subrogated shall have sixty days within which to make any payments or perform any covenants or conditions which are in default under the agreement of sale or lease as the case may be.

8. Subsection 1 of section 15 of the said Act is

amended by striking out the words "twenty per cent, or fifteen per cent. as the case may be," in lines four and five thereof, and substituting therefor the wording "percentage."

9. Subsection 4 of section 15 of the Act is amended by striking out the words "wage earner" in line three thereof, and substituting therefor the word "person."

10. Subsection 2 of section 22 of the Mechanics' and Wage Earners' Lien Act is amended by adding after the word "materials" in the first line thereof the words, "in case not otherwise provided for."

11. Section 22 of the said Act is amended by adding thereto the following sub-sections:

(6) If, within the time mentioned in sub-section 1, a sub-contractor has given to the owner or, in the case of a contract which is under the supervision of an architect, engineer or other person upon whose certificate payments are to be made, to such architect, engineer or other person, notice in writing of the sum owing to such sub-contractor by the owner or contractor, as the case may be, the claim for a lien for such sum by such sub-contractor may be registered within seven months after the time mentioned in subsection 1.

(7) If, within the time mentioned in sub-section 2, any person who furnishes or places any materials, has given to the owner, or in the case of a contract which is under the supervision of an architect, engineer or other person on whose certificate payments are to be made, to such architect, engineer or other person, notice in writing of the sum owing to such person by the owner or by the contractor or by a sub-contractor, as the case may be, the claim for a lien for such sum by such person may be registered within seven months after the time mentioned in sub-section 2.

Organization Scheme for Construction Industries Meeting With Approval

THE scheme for the organization of the building and construction industries suggested by Mr. H. Elgie, president of the Provincial Builders' and Supply Association, and published in the Contract Record of April 9th, is exciting favorable comment from the various exchanges throughout Ontario and is attracting especial interest in those towns where the builders and contractors have not locally organized. The building and construction industries are capable of vast development and it is gratifying to know that a feasible line of action is meeting with favorable response and creating enthusiasm among the contractors and supply men of the province of Ontario. As indicative of the reception that Mr. Elgie's organization scheme has attracted, we publish a letter from Sarnia, Ont., in which will be noted the efforts of the Sarnia Builders' Exchange to extend their scope and enlarge the usefulness:

Sarnia, Ont., April 5th, 1919.

Mr. H. Elgie.

Dear Sir:—Replying to your circular letter re organization of the builders and supply men of our city.

I might say we have made every effort to improve conditions and I believe that we can say that our efforts have not been in vain, and I will not be satisfied until every builder of the city is a member of the Sarnia Builders' Exchange. As a further indication of our effort to try and interest more of the contractors, we are inviting Mr. T. R. Wright and Mr. E. R. Den-

nis, of London, to give us a talk on April 18th on the advantages of organization in the building interests.

I enclose a clipping from a local paper and you will note that the local exchange is alive to the interests of the community, among the outside men appointed by the Board of Education in the interests of industrial education appearing the name of Thos. Grace as chairman. He is a live member of the local exchange. At our meeting last night we appointed five members as a committee to confer with the city council in the matter of framing the new city building by-law, with instructions to suggest to the city officials the necessary qualifications of the inspector.

In the past we have used the Board of Trade rooms for our meetings, but we feel that we should have quarters of our own and on the first of May we take possession of a room on Front Street that will be open to the members and their friends at all hours.

In your sketch plan of organization you have omitted the name of Sarnia, and while we have only seventeen members we wish it understood that we are a live bunch and at our meetings have 75 per cent. of our membership taking active interest in the affairs of the community.

We are pleased to hear from you at any time regarding anything of interest in the building line.

Yours respectfully,

Norris E. Gibb.

In handing the Contract Record this letter, Mr. Elgie commended Sarnia for its efforts. "Well done, Sarnia," he said, "but there are other cities and towns of Ontario that can accomplish what Sarnia has. They should get a line on Mr. Wright and Mr. Dennis, of London, if possible, for they are a good team, but if they cannot come, we shall be pleased to send some one from Toronto."

The Sarnia Builders' Exchange has been interesting itself in the establishment of an industrial and technical school in connection with the Collegiate Institute and recently memorialized the Board of Education to that effect. It is expected that several other organizations in the city will co-operate with the Builders' Exchange in this matter. That the Board recognized the value of the efforts of the Builders' Exchange is evident in their appointment of Mr. Thos. Grace, a member of the Exchange, as chairman of a committee of four appointed to take technical educational matters in charge. No definite steps have been taken as yet toward the appointment of an architect for a new collegiate institute and technical school, but the matter has been left in the hands of this committee, who will investigate the standing of any architects that may be suggested and take the necessary steps to get the matter started at the earliest possible date.

With a view to the extension of technical education in Ontario, the Honorable Dr. Cody, Minister of Education, has appointed Messrs. H. P. Cavin, B.A., principal of the Windsor Collegiate Institute and Technical Schools, and K. S. MacLachlan, of the Imperial Munitions Board, to the staff of the director of technical education. Their duty will be to study the general technical educational requirements of the employees in important industries and trades and to make constructive recommendations regarding the organization of education to provide better trained workers for these trades.

Councils in Building Trades

Montreal Builders and Contractors Hear Opinions on Establishment of Joint Industrial Councils

THE subject of advisory councils of employers and employees in the building trades was dealt with by Senator G. D. Robertson, Minister of Labor, and Mr. Wills Maclachlan, vice chairman of the Labor Sub-Committee of the Cabinet, at an informal smoker of the Association of Montreal Building & Construction Industries held at the Windsor Hotel, Montreal, on April 7th. Mr. John Quinlan presided at the meeting.

The Minister of Labor discussed the subject in an exhaustive manner. First of all he referred to the industrial unrest throughout the world, and said that Canada was not torn to such an extent as other countries, but the unrest was sufficiently prevalent to warrant serious attention. Why, he asked, did it exist? For three or four years everybody had been employed, and yet there never was such unrest in the labor world as at present. He desired to explain what, in his view, actuated this unrest, and what was the state of mind of many workpeople of Canada. It was not a state of mind peculiar to working people alone, because all people were viewing affairs in quite a different light since the war began. The working people of Canada had suffered more acutely during the war period than other classes, and the sacrifices they had made were greater to them than if they had been better situated so far as worldly goods were concerned. Fifty-five per cent. of Canada's armies were made up of wage-earners and they would appreciate that the sacrifices of those who went to the front were greater than those who left their families comfortably provided for. The men were now coming back, and in the main were not complaining, although he confessed that there were those who were making their voices heard in regard to what they believed were grievances.

Industrial Relations Have Changed

The relations between capital and labor had gradually undergone a change during the past twenty-five years. The evolution was so slow, however, that few had realized the change that was taking place. There were not in those days the large aggregations of capital invested in particular industries that were found today. Employers in almost every case were in daily contact with their employees; but with the growth of trade and the aggregation of capital, a change had taken place under which the workmen now had no individual contact with the employers, and in some cases did not even know who were the proprietors of the industry. Realizing that the standard of living was not sufficiently high, the Canadian workmen gradually began to organize themselves into groups commonly called unions, in order to deal with the employers. These unions had been largely recognized by employers, and they now had meetings with the employers to make arrangements, which were generally called collective bargaining. This was the prevailing condition until the war broke out. Up to that date not more than 25 per cent of the workmen were organized.

Adequate Pay

Having pointed out that the rise in wages had not kept pace with the advance in the cost of living, the Minister of Labor stated that today the workman felt

he should receive more recognition, and should be adequately paid, so that he might live with the same degree of comfort that he enjoyed in pre-war days. He was also convinced that he was worth more than he thought he was worth in the pre-war days. There had come a feeling of self-confidence that did not exist in those days, which was due to the loyalty, service and sacrifice that the working men of North America had shown during the struggle. Both the armies of North America and Europe were chiefly composed of workmen, yet they represented only a small proportion of the wealth that they fought to save, and did save. Many of them were taking the view that the progress of the past had been too gradual and too slow, and that it was no incumbent upon them to be more militant. In some countries that spirit had grown so that it had become a menace to society. Happily, this was not the case in Canada, and he did not believe that it would be so. This was a democratic country, and a great majority of the people were financially interested in the country. But it behooved all business men and employers of labor to give heed to the changing times, and to realize that this spirit would continue to grow among working men until they were convinced that they were being fairly treated.

Co-operation Essential

The Minister of Labor then referred to recent labor troubles in England, where it was only by the adoption of unusual methods that serious labor disaster had been averted. He hoped that in Canada employers and employees would profit by what had been done in the Old Country. If Canada was to prosper and develop industrially, there must be a maximum of efficiency displayed, not only by employers, but by employees. It was unfortunately true that too many men had sought to see how little they could do for their day's pay rather than endeavor to give honest service for reasonable compensation. Senator Robertson advocated a spirit of co-operation between workmen and employers as likely to bring about greater profit and satisfaction to both. Probably the building trades were not situated in quite the same way as some others, as here the employers were in daily contact with many of the workmen, and had not lost that personal contact to which he had previously referred. Even in the building trade he thought probably it was true that if the workmen felt the spirit of loyalty and co-operation and desired to do the best for the employer, their services would be more profitable to the employers if the latter would meet the requests for better compensation, so that the workers could enjoy a higher standard of living. He insisted upon the importance of inculcating the spirit of co-operation in all industry.

Having briefly touched on the American revolution, and the Civil War, the Senator said that in Canada we prided ourselves upon being a democratic country; but he asked whether it was not also desirable that where large capital was invested in a particular industry which was helpless to produce profit without the assistance and co-operation of the necessary labor, the advisability of that labor being consulted in the operation and management of the industry, so far as the interests of employer and employees were mutually concerned, should also be considered. He did not mean to suggest that workmen should have any voice in the spending of that capital or control of the money invested. Men were offering their services for a price, and the suggestion was that in the past they had not been consulted about that price, or even the conditions

of their services. Therefore, the spirit of unrest, and the feeling that the employer was not the friend but rather the enemy of the workmen had grown up until employers and employees were organizing against each other in the same way that nations had been organized against each other.

Many Industries Have Taken Action

During the last three years organized labor had increased its membership three fold. The thought that was prevalent in the minds of many employers and of thousands of workmen was, why should this process go on, and why should the situation become more acute? Why should there not be a spirit of co-operation and arbitration to settle differences rather than to foster a spirit of antagonism? It was most important to Canada, if we are going to carry on and pay our war burdens that every business activity should be actuated by a spirit of co-operation, and the rights of the other fellow should be recognized as well as our own.

The speaker points out that some of the larger industries were taking action along these lines, and he instanced the International Harvester Company, the Imperial Oil Company, the Canadian Shoe Manufacturers of Ontario, and the shipbuilders of Eastern Canada. The meeting of the latter he regarded as one of the most important conferences yet held because if the shipbuilding industry was to become permanent, it must be handled very carefully owing to the acute competition that would have to be met.

If the workmen could be brought to realize that there was a limitation to what the employers could pay in meeting their requests, many misunderstandings would be swept away, and in conclusion he suggested that the association might set the example of co-operative action and joint discussion of the problems which affected their industry.

Considering the Human Element

Mr. Wills Maclachlan, in the course of his speech referred to the investigation in England as to the conditions under which munition and other workpeople were employed, pointing out that these inquiries showed that shorter hours were conducive to greater production and better work. In a word, more consideration had been given to the human element than in the old days. In Ottawa a labor committee composed of representatives of employers and employees, social workers, and engineers had been appointed. In the Montreal Association it was good business to have conferences, even though those co-operating were competitors for trade, but in the past the employees had not been consulted. Manufacturers had been paying great attention to machinery, but not to the employees. In other words, the human element had not been consulted. If conferences were good in business, why should they not be equally good between employers and employees?

Mr. Maclachlan then dealt at considerable length with the special committee in Great Britain which had issued what is known as the Whitley Report, (a resume of which has already appeared in the Contract Record) embodying the scheme of joint industrial councils representing capital and labor in all matters pertaining to their mutual welfare. He outlined the subjects dealt with and the progress already made in Great Britain, remarking upon the recognition on the councils of organized labor. There was, he said, another form of industrial council in force at the plants

of the International Harvester Company, where the men were represented by those elected by secret ballot, a corresponding number representing the management. The council considered matters such as education, policies, hours, etc., leaving it to the management to carry out the decisions arrived at. In other words, the council was legislative and judicial, but not executive. The Imperial Oil Company also has another form of council, the problems in this case being worked out as they went along, there being no detailed plan.

Joint Industrial Council in Toronto

Mr. Maclachlan then gave details of the advisory council formed in Toronto at a meeting composed of representatives of the various sections of contractors and of the Building Trades League. Three preliminary meetings had been held and a constitution adopted. (This is given elsewhere in this issue of the Contract Record.) Mr. Maclachlan outlined the principal points of this constitution, stating that the council would be known as the Joint Industrial Council of the Toronto Building Trades.

It had been stated, he proceeded, that the Whitley scheme could not be adopted in Canada. It was true that no one plan was applicable to all conditions, but there was some plan that would work in every place, and it was up to them to find that particular plan. There were basic principles that would apply to all, and there were certain details that would have to be adopted. As an engineer, he suggested that the engineer was in an advantageous position in connection with industrial relations. Mr. Maclachlan urged that in dealing with men, employers, above all things, should not try to camouflage them, and not try to be paternal, as men resented this. He urged that co-operation should be the real key note in their relations with the men.

The arrangements for the meeting were made by Messrs. F. J. Parsons, F. B. Locker, A. W. Bremner, Donald Church, J. E. Walsh and A. Daly.

Vancouver Harbor Changes

In Report to Government Engineer Makes Suggestions for Development and Improvement of Harbor Area

EXTENSIVE port developments for Vancouver, B. C., are recommended by A. D. Swan, consulting engineer, engaged by the Dominion Government to make a thorough review of the Vancouver harbor situation and report regarding means for the development of the port. Although the report has not been made public and its details are still confidential, the Contract Record is advised by the Vancouver "Province" that Mr. Swan recommends the following undertakings as necessary and to be commenced as soon as possible:

- 1.—A booming ground for timber should be provided in English Bay.
- 2.—A timber export wharf provided in one or other of the alternative positions referred to hereafter.
- 3.—A harbor terminal railway.
- 4.—Provision for six new deep-water berths or wharves at once.
- 5.—Mechanical equipment provided at the new government wharf and other wharves when constructed.

- 6.—Equipment for non-inflammable oil storage in some suitable site.
- 7.—Provision of a fire tug, fitted with powerful crane, which tug shall be used as an auxiliary car ferry to serve immediate needs to North Vancouver.
- 8.—Provision of dockage facilities for passengers and other traffic in connection with the Canadian National Railway.
- 9.—Removal of present C. P. R. bridge across the entrance of False Creek at Kitsilano reserve, and if necessary, construction of a new bridge in a suitable location.
- 10.—Provision of suitable landing facilities at North Vancouver for auxiliary car ferry with railway connections.
- 11.—Second Narrows bridge should be constructed as part of the complete scheme, if not immediately, at an early date.
- 12.—Drydock to be constructed by government, if not arranged for by private interests, at early date.

The report just submitted is the second one made on Vancouver harbor by Mr. Swan. The first report, following a period of study of the harbor extending from December 12, 1911, to January 10, 1912, urged continuation of the work of widening the First Narrows; declared Burrard Inlet was the natural deep water harbor for ocean shipping; advised construction of additional wharfage on the harbor front from the C. P. R. pier; recommended additional wharfage east and west of the sugar refinery; advocated wharfage provision on the north shore of the Inlet; declared False Creek should be dredged and used as the centre of coastwise traffic; recommended the filling in of the upper end of False Creek to be used as a central railway terminal of all railway lines that may enter Vancouver, and advised dredging of the North Arm of the Fraser to permit light-draft craft using it.

Montreal General Contractors Discuss Building Problems

AT meetings of the general contractors' section of the Association of Montreal Building and Construction Industries, Mr. W. M. Irving, the president, advocated the opening of all tenders for building and construction work in the presence of those tendering or their representatives. A long discussion ensued and differences of opinion developed. Ultimately it was unanimously agreed on the motion of Mr. R. McLean, seconded by Mr. K. D. Church, that architects be invited to furnish the Montreal Association with the prices submitted on all their jobs without the names of those contractors competing being attached.

The chairman, in the absence of Mr. J. P. Anglin, reported that he had had an interview with the representative of the Bricklayers' Union of Montreal (Inc.) relative to a working agreement for the coming season. He explained that it was said of one of the two bricklayers' unions operating in Montreal that it had a membership of 400, and the other of 80, and it did not seem possible that these two unions could be brought to work harmoniously for the good of the trade. He wished for one union and in that case, he would advocate a working agreement on behalf of this section. It was accordingly moved by Mr. Walter Bonnell, seconded by Mr. J. H. Hutchison, and resolved that the chairman (Mr. W. M. Irving) appoint a committee to meet with

representatives of the Bricklayers' Union of Montreal (Inc.) to discuss the terms of an agreement for 1919 and report.

Commission to Administer Housing Fund

Acting on the invitation of the chairman of the Administrative Commission of the city of Montreal it was unanimously resolved to nominate the following, because of their long and varied experience in the building and contracting trade, as suitable members of the commission about to be formed to administer the fund for the erection of dwellings for workingmen in the city of Montreal: Messrs. W. M. Irving, president; J. P. Anglin, past president; John Quinlan, past president; and W. C. Munn, past chairman of the general contractors' section.

A letter from one of the members advocating the use of bid bonds in preference to accepted cheques and the adoption of this system by federal, provincial and civic governments was submitted by the secretary. The writer stated one of the advantages would be that "it would eliminate quite a few would-be contractors who have no plant and nothing at the back of them to fulfill the contracts that are awarded to them. You will bear me out when I state that a contractor can always secure the services of a friend of his to put up the necessary deposit in the form of an accepted cheque, but should he put up a bid bond his standing has to be made to the insurance companies, which is a guarantee of his capability of fulfilling the contract awarded to him." It was unanimously agreed, on the motion of Mr. K. D. Church, to defer consideration of this subject, and a committee was appointed, consisting of Messrs. Church, Evans and Stack, to study and bring in a report.

Creamery Company Plans Development

CONSIDERABLE construction work in connection with the operation of the Saskatchewan Co-operative Creameries at various points in the province will be undertaken; it was announced by officials of the Saskatchewan Co-operative Creameries, Ltd.

Residents of Melfort, Sask., have subscribed over \$60,000 stock for the construction of a creamery at that point which is estimated to cost \$50,000. The building will be a two-storey brick and concrete structure, the site for which has been acquired.

Foundations were put in last fall for a new creamery at Wawota. The work of building this structure which is to cost about \$8,000 will be proceeded with almost immediately and it is expected that the work will be undertaken by the engineering and construction staff of the company.

The new cold storage plant at North Battleford is near completion and it is expected that produce will be placed in the building early next month. Additions are also being made to the cold storage plant at Saskatoon to meet an urgent demand for more space.

Mr. A. S. Clarson, C.E., secretary of the Association of Canadian Building and Construction Industries, intends to make a tour of the principal Western cities with the object of establishing branches of the Association. At present he is engaged in preliminary organization work in Montreal, but as soon as this is completed he will start on the tour.

Present Status of Brick Pavements

The Advantages and Disadvantages of Construction on Sand Cushions, Cement Mortar Beds and Green Concrete Foundations

By Wm. M. Acheson

BRICK pavement construction since 1915 has been subject to far greater changes than the construction of any other pavement. These changes, through a more rational use of the same amount of material, have tended to greater strength and durability. In this article it is the intention to describe the three different types of pavement, or, it might be said, the old and the new methods, and point out the advantages and disadvantages of each.

Foundation Course

The foundation course is usually made of cement concrete and, in general, a 1:2½:5 and 1:3:6 mixture is specified, the thickness depending largely upon the character of the subsoil and the amount of traffic. While the cement concrete foundation predominates in brick pavement construction, many miles have been laid on foundations of compact sand, gravel and broken stone. Engineers will agree on the absolute necessity and economy of concrete as a foundation for brick and all types of block wearing surfaces, together with mixed types of bituminous pavements. In fact, to my mind, the time is here when highway engineers are called upon to design rigid types of construction to meet the demand of modern traffic, which means heavy motor-driven traffic. Engineers are now giving special attention to the different parts of a pavement in order to meet existing conditions. Metal reinforcement is sometimes specified to be imbedded in the concrete foundation over soft places and recently dug trenches. By this it is hoped to prevent the cracking which in the majority of cases comes from the condition of the subsoil. Experience has shown that an evenly built foundation which conforms to the finished cross-section of the road, will result in a uniform thickness of sand cushion and a smooth wearing surface. In this pavement, as in all other pavements, the key to the whole situation is the condition of the subsoil and the foundation, and in this phase, too much care cannot be exercised from the design or construction standpoint.

Sand Cushion

Brick pavements with a sand cushion or a bed course of plain sand have been built since the first brick pavement was constructed in 1870 and represent at the present time by far the largest percentage of the three types. The thickness of the sand cushion called for in the older specifications in constructing this type of pavement has been considerably greater than advocated by most engineers at the present time. The theory advanced in behalf of the sand cushion is that it served the double purpose of providing a uniform bearing for the wearing surface and supplied resiliency under traffic. With this in mind specifications called for sand beds not less than two inches in thickness, many of which were not given the proper care in constructing and were formed by screeding out the full thickness at one time without necessary consolidation by hand-rolling. This was responsible for failures in the brick wearing surface which en-

gineers traced directly to the non-uniformity of the sand bed. An endeavor was made to correct this in later specifications by calling for a sand cushion of not over one inch in thickness together with requirements as to its gradation by sieve analysis and the amount of loam permissible in the sand used.

Defects of Sand Cushions

Present day specifications describe carefully the manner of forming or building up the sand bed by screeding it in layers and rolling in order to form as nearly as possible a uniform bearing for the wearing surface.

Notwithstanding all the precautions and refinements of the later specifications where a sand bed is used, it has been shown that the defects were not overcome in the wearing surface, this being due to the fact that it is impossible to properly compact a sand bed varying in moisture content and thickness. Also, a wet sand cushion when dried out will shrink and leave hollow spaces, consequently defeating its function of providing a firm and uniform bearing at all times for the wearing surface. Another defect of the sand cushion is that it works up into the joints of the brick, preventing the joint filler from thoroughly penetrating and properly bonding the wearing surface. In the repairing of many of our brick roads I have seen defects in the surface caused by the sand cushion coming up into the pavement at least 2½ inches.

Wearing Surface

The wearing surface of the pavement is composed of vitrified paving brick joined together with a filler. Small bricks without lugs were used in the early days for brick pavements. Later, in order to obtain a uniform width of joint to take the filler the bricks were made with lugs by repressing. The standard paving brick of to-day is 3½ inches in width by 8½ inches in length by 4 inches in depth, laying 40 brick to the square yard. These brick are larger than the first brick manufactured.

The wire-cut lug brick came into vogue in 1910. These brick have steadily increased in favor with paving engineers and are now universally called for. The wire-cut lug brick possesses uniform lugs and fiber sides, due to the method of manufacture. The fiber sides, which are always obtained in a wire-cut brick, give a greater bond strength at all times, while the uniform lugs insure a thorough and even penetration of the filler, and from a construction standpoint provide parallel joints, which mean better construction. The square edge of a wire-cut brick in addition means a flush joint, which produces at all times a smooth wearing surface and one which will not cobble under traffic.

Joint Fillers

Two classes of joint filler are used to bond the brick units together, the cement grout filler and the bituminous filler. My experience and observation are that the results from the cement grout filler are superior and more durable than the soft filler, and that it

is absolutely necessary in the modern semi-monolithic and monolithic types of construction. If soft filler is used the old sand bed is more likely to be the design. In general, the specifications of to-day call for a grout made of one part cement to one and one-half parts of sand. Machine mixed grout is, in the opinion of most paving engineers of to-day, far superior to hand-mixed, and at the same time is more economical in manipulating. Paving engineers recognize the necessity and importance of the grout filler and are taking every precaution in the selection of the materials and their application.

Brick Pavements with Cement Sand Beds

Experience and observation have demonstrated that many failures in the wearing surface, which engineers have endeavored to combat, are due to the sand cushion. The solution of this factor has been the development of the cement-sand bed, which provided a non-shrinking, rigid super-foundation, thus making the first step toward a brick monolithic type of construction. Brick pavements constructed with a cement-sand bed are commonly known as semi-monolithic, and from this type developed the true brick monolithic construction. The semi-monolithic type is the same as a brick pavement constructed with sand cushions, except that a mixture of sand and cement mixed, in general, one part Portland cement to three parts sand, is substituted for the sand cushion. It is the practice to thoroughly mix these materials dry by machine, in the proportions specified. The mixture, when spread out, should be screeded with a templet cut to the required contour of the finished pavement. Care should be taken to get uniformity, but hand rolling is not deemed advisable, as it has been learned that a rolled cement bed does not insure a smooth wearing surface, due to its great density. With an unrolled surface the brick, as laid, is always bedded in the cement sand super-foundation. The thickness advocated in general is a minimum of $\frac{3}{4}$ inch and a maximum of 1 inch. It is my practice to wet the cement-sand bed with a sprinkling can just ahead of laying the brick. Immediately preceding the grouting the brick surface should be thoroughly wet.

With present methods the semi-monolithic type of construction is better adapted to wide street construction than the monolithic. All precautions should be taken in the mixing and the application of the grout filler.

Unites Wearing Surface With Foundation

One advantage of semi-monolithic construction is that it overcomes the defects of the sand cushion by insuring rigid construction, in that it practically unites the wearing surface with the concrete foundation. The cement-sand cushion at all times provides a perfect bond for the full depth of the brick. This type eliminates the shrinking which is common in a sand cushion, and at the same time eliminates the hollow or rumbling noise which is common with the sand cushion type of construction. It gives a more economical and scientific design in that it provides a stronger slab with the same material.

Brick pavements with cement-sand beds were built in Baltimore as early as 1906 and adopted as their type of construction in 1915. The cement-sand bed was used in Jacksonville in 1910, and also in connection with the paving of the ramps of the Pennsylvania Railroad terminal in New York, in 1910.

It has been demonstrated here that shallow vitrified brick will stand up under heavy truck conditions when laid upon a cement-sand bed. In this case, fire clay brick $2\frac{1}{4}$ inches in depth were used.

Green Concrete Foundations

This type of construction is commonly known as the monolithic type and is better adapted for roads up to, say, 24 feet in width, or where a templet may be used to shape the entire width of road at one time. It was first used in highway construction near Paris, Illinois. Proper consistency of the concrete foundation is essential for this type of construction. Care should be used in the proper spading and distributing of the concrete to prevent waves in the finished pavement due to possible difference in density. The concrete foundation is spread usually $\frac{1}{2}$ inch high and formed by using a tamping templet which brings to the top a smooth mortar surface, on which to bed the brick.

For this purpose there has been developed a mechanical templet which consists of a gasoline engine mounted on a cross frame with wheels, which is carried on the side forms. This power templet performs the double purpose of tamping and smoothing the concrete and, in addition, compresses it to greater density. This templet moves at the rate of 4 feet a minute, and can be adjusted to different widths. The laying of the brick-wearing surface should follow closely after the laying of the concrete foundation, and should be inspected, culled and rolled before the cement has its initial set. For rolling the wearing surface a hand roller is advocated about 30 inches long, 24 inches in diameter, weighing from 600 to 900 pounds. The rolling should follow immediately after the inspection, so that the grout filler may be applied at once to secure the necessary bond with the concrete foundation.

In this connection the so-called wire-cut lug brick is of special value in that it develops the full strength of the slab by reason of its superior side bond, due to its fiber sides, and assures penetration of the bonding material to all parts of the joints due to its uniform lugs. The mixing and placing of the grout filler is of the utmost importance for this type of construction, as in the construction of brick pavements of the other types and the same precautions must be taken in the selection of the materials and their application.

All the advantages claimed for the semi-monolithic type of construction will hold for the brick pavements constructed on green concrete foundations, in addition to which may be mentioned the added increment of slab strength due to the more perfect bond of the wearing surface and the concrete foundation. This type also eliminates the use of edges in highway construction, which reduces the cost. The use of the semi-monolithic and monolithic types have tended to develop the use of paving brick of less thickness, which will result in economies, one of the most important being the saving in transportation charges. There should also be economy in the first cost together with a saving in actual manipulation.

In my opinion the day of the sand cushion on a rigid foundation is ended and the satisfactory type is a cement-sand cushion for village and city streets, and a green concrete foundation for highways.

This paper was presented by the author at the recent convention of the American Road Builders' Association.

Segment Blocks for Drains

Have Advantages in Large-Size Installations—
Their Lightness an Important Factor

ALTHOUGH segment blocks have been used in the construction of sewers for some time, their entrance into the field of tile drainage has been only within recent years. Segment blocks are somewhat similar to building blocks in that they are hollow, with interior walls so arranged as to obtain the maximum strength. They are made of clay, vitrified and salt-glazed, with tongue-and-grooved side joints and with either square ends or ship-lap end joints. In sewer construction the aim is to have a water-tight conduit, while in drainage work the joints should be only closely butted together in order to permit water to enter the drains. Thus in sewer construction all joints of segment blocks are cemented.

In drainage work, usually, none of the joints is cemented. However, in main drains of large diameter the necessity of permitting the water to enter the joints is not so important, since the submains and laterals deliver the water to the main, and cementing might be desirable, but, to make the contractor cement all joints to give additional strength would increase the cost of constructing segment-block drains. Manufacturers of segment-block conduits in many cases have underbid manufacturers of large cement tile. A comparison of the cost of segment-block and solid-tile drains is made in Engineering News-Record, to which this article is due, by D. L. Yarnell, Senior Drainage Engineer, Bureau of Public Roads and Rural Engineering.

Comparative Cost

Although segment-block drains of 30 inches in diameter are made, the smallest size used in drainage work, so far as the writer knows, is 36 inches. The largest segment-block drain laid, to the writer's knowledge, is 52 inches in diameter, while the largest concrete tile manufactured is 50 inches.

It is interesting to compare the cost of the solid tile with segment blocks. The following table gives comparative costs obtained during July, 1917:

Prices Per Lin. Ft. F. O. B. Factory

Size, in.	Segment block (No. 2 grade)	Cement tile	Size, in.	Segment block (No. 2 grade)	Cement tile
30	\$1.08	\$1.175	40	.....	\$2.040
32	.....	1.275	42	\$1.62	2.250
33	1.19	.....	44	.....	2.475
34	.....	1.425	45	1.74	.....
36	1.30	1.650	48	.....	2.940
38	.....	1.875	50	.....	3.200
39	1.51	.....			

On the Hamilton County, Iowa, Drain No. 4, the bids received for 3,750 ft. of 39-in. tile delivered along the line of drain were as follows: Solid tile, \$11,452; segment-block, \$8,851 and \$8,993.

The complete bids received on this drain for labor, and furnishing and hauling tile, were as follows: Using solid tile, \$15,500; using segment-block, \$12,800.

From these data it may be inferred that the cost of installing segment blocks is about the same for solid tile; however, that may not be true under all conditions. It should be noted that this drain was laid in the bottom of an old ditch, the average cut being about six feet.

On the Webster, Hamilton and Boone Counties, Iowa, Joint Drain No. 1-192-210, bids on the following

size of tile delivered along line of drain were received: 1,460 ft. of 52-in., 850 ft. of 48-in., 600 ft. of 42-in., and 6,250 ft. of 39-in. A segment block manufacturer was the lowest bidder and was awarded the contract at a cost of \$23,895.

Difficulties With Segment Block Drains

In construction the contractor lays the invert block to grade. The other blocks are then added, and the space around the tile is filled with earth. The last block on top, the key block, is usually slipped in place by hand, few drainage contractors using the arch form recommended by segment block manufacturers. The arch form consists of an adjustable semi-circular form mounted on a V-shaped frame. This form is designed to facilitate the laying of the upper blocks of the drain, being pulled ahead in the drain as the construction progresses. Of course, all joints on the drain are staggered.

If either tile or segment block drains are laid in trenches constructed in stiff soil where sheeting is unnecessary, excellent work can be done. The writer has seen segment block drains laid so true that the most exacting person could not find fault. However, in unstable soil, where sheeting is necessary, some trouble may be experienced after the blocks are laid and before the trench is back-filled. So far as the writer has observed, no failures have occurred after the trench has been back-filled. When the soils are unstable the lateral pressures in some cases are so great, before the trench is filled, as to cause the drain to collapse. The resistance of the drain to lateral pressure is increased by back-filling. Where sheeting is necessary, the back-filling must sometimes be done before the sheeting can be removed, and the contractor must leave it in. Resistance of the drain to lateral pressure can also be increased by cementing the joints. By leaving an occasional joint between the ends of blocks uncemented, water can be admitted to the drain. In back-filling the drain, great care should be exercised to see that the earth is carefully tamped between the drain and the side of the trench, until it is well above the springing line. Even in the best of material the trench should be back-filled as rapidly as possible after the blocks are placed.

Segment Block Suitable for Large Sizes

The limit to the size of clay drain tile (due to the limits in size of machines used in manufacturing), is approximately 30 inches, and for concrete tile, due to handling, about 50 inches. Thus the segment block, on account of easy manufacture and handling, fills an important need for the larger sizes of drains. With large tile, where sheeting is necessary, the bracing must be far apart to admit the large tile. With segment blocks this trouble is eliminated.

The comparative weights of segment blocks and concrete tile are given in the following table:

Size in.	Segment block		Concrete tile	
	Weight per block Lb.	Weight per lin. ft. of drain Lb.	Weight for each tile Lb.	Weight per lin. ft. of drain Lb.
30	54	270	750	300
36	54	324	1,100	440
42	58	406	1,800	600
48	72	504	2,355	785

Thus it can be seen that the lightness of segment blocks constitutes a great factor in the shipping and hauling of material. The segment block is compact and light, compared with solid tile. The loss due to breakage is not so great, since, if a block is broken the

loss is slight, whereas if a concrete tile is broken, one entire length is gone. With a 42-in. drain the loss due to breakage of one segment block is 12c., as compared with \$2.25 for a broken concrete tile. In spite of the difficulties of construction in unstable soil, there is no doubt that the use of segment blocks for tile drains will increase, due to the lightness and convenience of handling and the advantages in laying.

The above investigation was made and the report prepared under the direction of S. H. McCrory chief of drainage investigation, Bureau of Public Roads and Rural Engineering.

Saskatchewan Merchant Booster for Good Roads

ROBINSON, MacBean Limited, who operate a general store at Moose Jaw, Sask., have completed their second annual road competition, and in connection with the final report, they comment as follows:

"This year's (1918) competition covered a territory from Eyebrow on the north to Hearne on the south, and from six miles west of Caron to five miles east of Belle Plains. Eighteen entries were received totaling almost seventy miles.

"Preliminary inspection was made on the first of June, and a certain number of points up to a maximum of forty, depending upon the condition of the road at the beginning, were allowed each entry. In this way the road which happened to be in a poor condition at the start was given a handicap over the road in good condition. An allowance up to ten points was also made in cases where the soil was difficult to work

Freedom from weeds 20 pts.
Amount of Traffic 20 pts.
General appearance 20 pts.

"In each district a first prize of one hundred and fifty dollars (\$150.00); a second prize of one hundred dollars (\$100.00), and a third prize of seventy-five dollars (\$75.00) is being paid, the prize money to be divided seventy-five per cent. (75%) to the municipality in which the road is located, and twenty-five per cent. (25%) to the operator who has the work in charge during the season. Considerable work has been done this season in the Moose Jaw district in addition to that entered in the competition, the Municipality of Moose Jaw, No. 161, having graded about eighty miles of road this summer. In concluding this year's competition we wish to acknowledge the assistance of the Department of Highways, Regina, who made the monthly inspections; also the courtesy of the Moose Jaw papers for publishing the monthly reports, and of the officials and councillors of the different municipalities for their kindly interest in the competition."

Active Building Season for Regina

BUILDING operations in Regina during 1919 will total an amount between \$2,500,000 and \$3,000,000, according to estimates based on information received from well-informed sources. L. A. Thornton, city commissioner, stated that he anticipated a healthy improvement in construction over the figures of 1918, while Mayor Black also expressed a feeling of optimism as the result of various indications.

W. G. Van Egmond, architect, agreed that the indications were for an active building season in Regina, and that many buildings contemplated before the war would doubtless be resumed and completed this year.

Several new buildings and extensions are under consideration—plans being already drafted in some instances—by wholesalers on the north side. The programme also includes two apartment houses and a business block. Most of the firms, who are included in the estimate, are preparing their building programmes, but are not ready to publicly announce their plans owing to competitive reasons.

The decision of the provincial government to spend almost \$500,000 on buildings in Regina during 1919, was looked upon by many business men as an inducement for action on the part of those who showed timidity in regard to the reconstruction period. It is believed that the government's action will give an impetus to building in Regina.

Link Belt Company Opens Montreal Office

The Canadian Link-Belt Company, Limited, announce that they have opened a branch at 1195 St. James St., Montreal. A liberal stock of popular types of Link-Belt will be carried in stock at Montreal, from which all orders in that section will be promptly filled. This will not only enable the company to render its customers a more prompt service than has hitherto been possible, but will also effect for them a considerable saving in freight and express. For the present, the Montreal branch will serve largely as a warehouse, all engineering assistance being rendered by the company at Toronto, where Link-Belt is manufactured. Although shipments for the Montreal and Quebec territory will be shipped from the Montreal branch, all correspondence should continue to be addressed to the company at Toronto.



This road won highest number of points in contest

and an extra five points per mile were given for every mile of three. The entries were all inspected every month during the summer by a representative from the Department of Highways, Regina, and points awarded according to the following schedule, twenty points being the maximum that any entry could earn during the summer under any one head:

Improvement of road in crown 20 pts.
Improvement of road in hardness 20 pts.
Improvement of road in smoothness 20 pts.
Condition of ditches 20 pts.

Depositing Concrete in Water

Acceptable Methods of Placing Concrete Under Water—Drop Bottom Buckets, Tremies, Bags, Pre-moulded Blocks

IN a report submitted recently at the annual convention of the American Railway Engineering Association a sub-committee of the Committee on Masonry presented the following data as representing in its opinion the best practices to be followed in depositing concrete under water:

In general, where it is possible, the depositing of concrete under water should be avoided, even if such action results in additional expense and possible delay of the work. There is always considerable uncertainty as to the results obtained, and the committee believes that where conditions will permit, the additional expense and delay of avoiding it is well warranted.

In view of this uncertainty, the need of close supervision by men competent to handle this class of work is of the utmost importance, and concrete should never be deposited under water without experienced supervision. Many failures which have occurred, especially where the structure is located in sea water, can be directly traced either to ignorance or lack of supervision. Frequently the work is done under the supervision of men inexperienced in this class of work rather than to go to the expense of hiring capable men.

Advisable Methods

Of the methods used, the following seem to give the best results:

The concrete is lowered in large buckets having a hinged bottom which sets sufficiently far above the lower edge of the bucket so that it may open freely downward when the bucket reaches the surface upon which the concrete is to be deposited. The top of the bucket is left open, and care is taken to see that the bucket is completely filled before lowering. Efforts made to use a closed top bucket have not been successful, due to the disturbances of the deposited concrete by inrush of water as the bucket is withdrawn.

The concrete may be passed through a vertical tube or tremie reaching down to the surface upon which the concrete is to be deposited. In this case the tube should be kept filled with concrete at all times, and the flow should be as nearly continuous as practicable.

Jute or cloth bags, from two-thirds to three-fourths filled, have been used successfully. These are placed in a header and stretcher system so that the whole mass is interlocked.

Where it is difficult to construct a cofferdam or monolithic work is not required, premolded concrete blocks of large dimensions have been used successfully.

A concrete depositing bag made of canvas or other suitable material is a variation of the bucket system. This is filled and the mouth of the bag closed by one turn of a line so looped that a pull on the line will release it. The bag is lowered mouth down to the surface upon which the concrete is to be deposited, and a sharp pull on the line opens the bag and permits the concrete to be deposited. This method does not have the disadvantage of the closed top bucket, since the bag will collapse as the concrete flows out.

There are a number of other methods that have

been used, such as depositing directly through the water; depositing a portion of the concrete by one of the above methods in the corner of the form and the balance progressively from wheel-barrows or buckets on the sloping surface, thus gradually filling the form; allowing the concrete to partially set in air and then depositing it in a plastic condition; depositing the concrete dry without the use of water; attempting to grout a foundation composed of riprap or coarse gravel by means of pipes sunk at intervals into the foundation. Although occasionally fair results have been obtained, all of these methods are dangerous, as they almost uniformly result in segregation of the materials or the washing out of the cement.

Depositing With Drop Bottom Buckets

The drop bottom bucket should be so arranged as not to discharge the load until the bucket reaches the surface upon which the concrete is to be deposited. In lowering the bucket, care should be taken that unnecessary wash is not produced. This may be avoided by slowing up the operation when the bucket is passing through the water. The bucket, when the load is discharged, should be withdrawn slowly until clear of the concrete. In depositing concrete under water by this method it is imperative that the work be continuous and sufficiently rapid to insure bonding of the successive layers. By this means the laitance formed can be brought to the finished surface and later removed after the concrete has hardened. There are a number of other types of buckets, such as the tipping bucket or bottom dumping bucket. The use of all these should be avoided, as they tend to stir up the material and wash out the cement.

Depositing Through Tremie or Vertical Tubes

This device should be about 14 in. or 16 in. in diameter, made up in sections so that the length may be adjusted to the depth of the water. The joints should be made flanged and the tube put together with gaskets, in order to avoid leakage of the water into the tube. The top should be flared, in order to receive the concrete properly. The tube should be suspended in such manner that it may be moved laterally as required. The upper end is placed near the level of the working platform, while its lower end rests on the surface upon which the concrete is to be deposited. When the operation starts the tube should be filled in such manner that the concrete is not permitted to drop down through the water. This is accomplished in several ways: One is to place the bottom of the tube in a box, partially filling it with concrete so as to seal the bottom, then lowering the box into the position in which it is to be used. Another method is to plug the tube with cement sacks or other material, which will be forced down as the tube is filled with concrete. In both these methods undesirable material is introduced into the concrete, but if the area to be covered is large this is a matter of minor importance. However, the first deposits from the tube should be kept away from the edge of the work. One requisite of this method is that the tube must at all times be kept filled with concrete and the greatest care exercised to see that the charge is not lost in moving it about the bottom. In case it is lost, the tube should again be filled as at first. One of the disadvantages of this method is that unless the greatest care is exercised, it is almost impossible to avoid losing the charge occasionally. This will depend very largely on the quality of the supervision exercised over the work. Another disadvantage of this method is

that the area over which it can be used is limited, and if it is necessary to deposit concrete over a large area a number of tubes should be used. With this method, as with all others, it is desirable that the concrete be deposited continuously from the time the work is started until it is brought above the water level or to the finished surface, which can later be cleaned in the air after the concrete has hardened.

Considerable difference of opinion exists among engineers as to whether the concrete to be deposited by this method should be made wet or dry. In the first case the concrete is made quite wet and the bottom of the tremie submerged several feet below the surface of the concrete as deposited. The material is allowed to flow out of the tube and seek its own level. In depositing the concrete dry, just sufficient water is used to make it plastic and the concrete is distributed by moving the foot of the tremie over the surface. Good results apparently have been obtained from each of these methods, but the opinion of the committee is that the dry method is preferable. If the concrete is deposited wet considerable difficulty is encountered in keeping the tremie full and more or less segregation of the materials is bound to occur. It is extremely difficult to move the tube when sufficiently submerged in the concrete to permit the wet concrete being used.

Bagging Method

While the bagging method insures good concrete and will prevent the formation of laitance, it is open to the objection that a monolithic foundation is not secured. Where, however, the walls of the foundation formed by the bags will not be exposed to scour, the committee is of the opinion that the method will give satisfactory results. This method can be used to advantage in sealing the foundations of cofferdams where it is impracticable to prevent inflow of water through crevices in the bottom. In using this method it must be borne in mind that satisfactory results cannot be obtained unless the bags are carefully placed by hands, and this makes the service of a diver necessary except where placed in very shallow water.

Premolded Concrete Blocks

Premolded concrete blocks can be used to advantage on a prepared foundation in large structures such as breakwaters, bulkheads, lighthouse foundations, seawalls—any heavy construction where the units can be large enough not to require bonding. The blocks are usually molded in the air in units weighing from 15 to 20 tons, and are deposited in place by the use of derricks.

Materials and Mixing

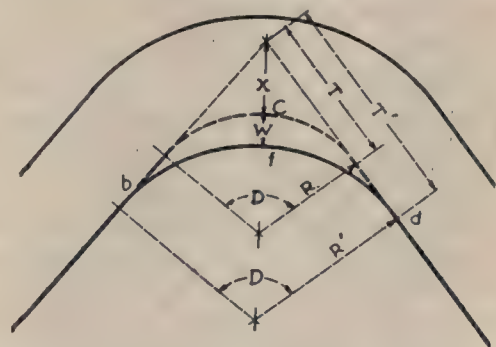
Concrete to be deposited in water should be of a richer mixture than when deposited in air, and a leaner mixture than 1:2:4 should not be used. It is the opinion of the committee that only so much water should be used as will make the concrete of a plastic consistency. Very dry concrete is as undesirable for this purpose as wet concrete. It is the opinion of the committee that washed gravel of somewhat smaller size than used in the open air concrete will give the best results. This is particularly true where the tremie method is used. The sand should be free from loam and other material, and it is preferable that washed sand be used where possible to obtain it. The aggregate should be capable of producing dense concrete, and it is recommended that tests be made of the materials available to determine the best aggregate for this purpose.

In depositing concrete under water it is imperative that the water be still and that the concrete shall not be exposed to current until it is fully set. This requires that a cofferdam be constructed in such manner as to insure quiet water within the cofferdam. One of the essentials of depositing concrete by any of the above methods is that the concrete be disturbed as little as practicable during the depositing, thus avoiding the formation of laitance. It is impracticable in depositing concrete in water by any method to entirely avoid laitance, and it is therefore necessary on completing a section of concrete to see that the laitance is entirely removed after the concrete has thoroughly set and before the work is resumed. For this reason it is the opinion of the committee that when a job is started the concrete should be deposited continuously until the finished surface is reached or the concrete brought above the water level so that the laitance may be removed in the air, as it is difficult, if not impracticable, to entirely remove it under water. The formation of horizontal construction joints under water should be avoided.

The ordinary precautions used in depositing concrete in the air are not sufficient when depositing concrete in water, and additional care must be observed in the latter case to prevent segregation of the materials, the formation of laitance, and to insure proper setting of the mass. Because of the fact that cold retards setting, the concrete should not be deposited in water the temperature of which is low enough to cause serious retardation. Concrete should be thoroughly mixed before it is deposited in water and, therefore, hand mixing should never be permitted, but a batch mixer used.

Widening Turns on Concrete Highways

THE tendency of a motorist to "cut the corners" is due to his unconscious desire to give the path of his car around a turn the longest possible radius. Many highway engineers recognize this tendency by widening the concrete pavement on the inside of the curve. The practice adds much to the attractive appearance of the highway. If the



pavement is the same width around the curve as on the tangents, the curved section appears narrower than the normal width; whereas if the curved section is widened gradually to the mid-point of the turn, the pavement appears to have a uniform width all the way around.

This added area on the inside of the curve is a "lune." The New York State Highway Department makes the maximum width of the lune, at the mid-point of the curve, four feet for curves of 300-foot radius or less; three feet for curves from 300 to 550-foot

radius; and 2 feet for radii from 550 feet to 800 feet. The Ohio State Highway Department frequently widens as much as 8 feet at the centre of the sharper curves.

In order that the lune may fit the curve properly, and not appear "broken-backed" it is necessary to have the curve of the inner edge a true arc, tangent to the edge of the straightaway sections, and therefore it must start before the point of curve is reached. The lune may be easily staked out on the ground with transit and tape, by means of data derived from the radius and central angle of the centre line curve.

On the accompanying sketch, from Concrete Highway Magazine, R is the radius of inside edge of the pavement, if it is of uniform width around the curve, R' is the radius of the inside edge when the curve is widened by W .

$$X = R (\sec D/2 - 1)$$

$$R' = (X + W) / (\sec D/2 - 1)$$

$$T' = R' \tan D/2$$

The area of the lune bcd in square yards is

$$\pi D/360 (R^2 - R'^2) + (R + R') (T' - T)$$

$$T = R \tan D/2$$

$$T' = R' \tan D/2$$

The New Price Revolution

By Irving Fisher

AT the present time there is a marked halt in production. Industry is slowing down. Unemployment of labor increases. Some industrial concerns are failing to earn profits, and others are suffering the dissipation of their accrued profits, because, even by shutting their plants down, they cannot save certain of their expenses or any of their fixed charges. The government's revenues, dependent as they are upon the national income, may fall short at the very time we need them most. In brief, we are threatened with a widespread business depression and from peculiar causes, for the unsound conditions usually preceding a widespread business depression are absent.

Belief That Prices Must Drop

The main reason why business is not going ahead better is that most people expect prices to drop. The merchant is selling, but not buying. The manufacturer holds up the purchase of his raw materials. People quote the disparity between present prices and those prevailing "before the war," and decide they will not buy much until present prices get down to "normal." This general conviction that prices are sure to drop is putting a brake upon the entire machinery of production and distribution. Readjustment waits because we keep on waiting for it. We have waited in vain for over three months. It is interesting to observe that many manufacturers think that prices must come down, including the price of labor, but they are ready to demonstrate to you that their own prices cannot come down, nor can they pay lower wages. Almost everything they buy somehow costs twice as much as before the war, and their labor is twice as dear. They cannot pay their labor less if labor is to meet the increased cost of living. Now, as a matter of fact, when we investigate almost any individual one of the so-called high prices for industrial products we are likely to find that individually it is not high; that is, it is not high relatively to the rest. Our quarrel is with the general level of prices.

Variations in the general price level may be compared to the tides of the sea, while individual prices may be compared to waves. Individual prices may vary from this general level of prices for specific reasons peculiar to individual industries, just as the height and depths of waves vary from the general level established by the tide. The causes controlling the general price level are as distinct from those controlling individual prices as the causes controlling the tides are distinct from those controlling individual waves.

Individual Versus Universal Price Influences

All prices have risen, but some have risen more, some less than the average for particular reasons affecting each industry. In some cases an improved organization of both employers and employees has enabled them to combine against the public and take full advantage of the price advance. The war brought about an abnormal demand for certain products like copper and steel, and they advanced faster than the average. The abnormal demand having disappeared, these prices are being adjusted downward. Wheat is a case where demand increased and at the same time certain of the usual sources of supply—Russia, Australia, and Argentina—disappeared, with a resultant abnormal price increase. The closed sources of supply have opened again, and wheat prices in the world market have dropped. In some cases, as in many of the industries making building materials, the war meant a great slackening in demand, and enforced curtailment in use by government order. In such instances we are likely to see an upward swing in prices as the suppressed demand again makes itself felt. To-day we are witnessing throughout the country such price readjustments, up and down, but the general price level has shown little sign of falling, as is evidenced by price index numbers. It is apparent to every thoughtful observer that some great force has affected all prices, creating a new standard to which they are all conforming.

The fundamental practical question confronting business men is whether the general level of prices is going to fall. In my opinion, it is not going to fall much, if at all. We are on a permanently higher price level, and the sooner the business men of the country take this view and adjust themselves to it the sooner will they save themselves and the nation from the misfortune which will come if we persist in our present false hope.

Business men should face the facts. To talk reverently of 1913-14 prices is to speak a dead language to-day. The buyers of the country, since the armistice, have made an unexampled attack upon prices through their waiting attitude, and yet price recessions have been insignificant. The reason is that we are on a new high-price level, which will be found a stubborn reality. Business men are going to find out that the clever man is not the man who waits, but the one who finds out the new price facts and acts accordingly.

The above remarks are from an address read last month by the author before the Conference of U. S. Governors and Mayors.

The Canadian Allis-Chalmers Co. announce that their stock has been increased with the reduction in prices at the mills and their facilities generally improved in the structural department. They further state that they can make quick shipments for large or small items at a lower cost than the U. S. prevailing warehouse rates.

Canadian Firm to Manufacture Excavator

The Engineering & Machine Works of Canada, Ltd., St. Catharines, Ont., announce that they have secured the rights for Canada and the British Empire, less certain portions, where selling arrangements already exist, to the Keystone Excavator, Model 4. In the United States, this excavator is built by the Keystone Driller Co., Beaver Falls, Pa., and the Engineering & Machine Works of Canada are erecting and equipping a plant at St. Catharines to manufacture it for distribution in this country and overseas. They expect to start making deliveries during the month of May, selling the machine for substantially the same price at which it is sold in the United States. This excavator, simply by changing to the proper form of shovel or scoop, can be used as a steam shovel, as a ditch digger and back filler, and as a dirt loader, for loading and unloading hopper cars with clam shell bucket. It is especially adapted to good roads and street work.

Mainly Constructional

East and West—From Coast to Coast

Verdun, P. Q., will make application for a loan under the government's housing scheme.

A new wharf at Lachine and a new post office at Verdun are among the appropriation items recently approved.

Survey for a new dock to be built at The Pas, Man., has been begun by G. Davies, of the Department of Public Works.

Business men of Meaford, Ont., have formed a company for the development of the oil lands owned by Mr. Ben Doran in that neighborhood.

With a capital of \$20,000 the Closse Construction Co., Ltd., has been formed to carry on the business of contractors and builders. The head office is in Montreal.

The excavation for the new T. Eaton warehouse at Moncton, N. B., is to be completed by the end of this month. B. Mooney & Sons are the contractors for this part of the work.

The sum of \$237,750 will be spent on "Good Roads" in Lincoln county, Ont., this year, according to the recent decision of the council. Tar macadam will be laid and a standard width of 16 feet has been fixed upon.

The Megantic & Stanstead Quarry Co., Ltd., Montreal, has been formed with a capital of \$49,000, to acquire the business of La Compagnie de Granit de Megantic, Ltd., and to carry on the business of general contractors.

The Automobile Association of South Waterloo, Ont., is supporting the proposal to have the stone road from Dundas to Elmira, passing through Galt, Preston, Kitchener and Waterloo designated as a provincial county highway.

The town council of Newmarket, Ont., has adopted a committee report recommending that issue of debentures to the value of \$110,000 to cover the cost of a sewerage system. A by-law on this proposition will be submitted to the rate-payers at an early date.

The waters of Shoal Lake flowed through the big concrete aqueduct and reached the mains of the city of Winnipeg on Saturday, April 5. There has been some discussion as to whether a filtration plant will be necessary, as there is a possibility that the water may not be pleasant for con-

sumption in its raw state, though tests by Mr. A. Blackie, the City Chemist, so far show nothing objectionable from a health standpoint. The hard water has now been driven out of the city's mains, however, and the citizens have the opportunity of judging for themselves whether they want a filter installed.

Nine building permits, valued at \$21,880, were issued in the city of Kitchener, Ont., during the month of March, while in March, 1918, the estimated value was \$14,970. The total for the first three months of the year is \$124,140, as compared with \$18,995 in the corresponding period in 1918.

The Ottawa Board of Control has recommended to the city council that a by-law be passed bringing the city under the Ontario Housing Act, and that a housing commission be appointed, consisting of the following: J. A. Cameron, J. U. Vincent, C. P. Meredith, J. A. Machado and Walter Todd.

At least \$75,000 worth of new pavements will be constructed this year in Galt, Ont., City Engineer Fairchild states. It is also possible, dependent upon an agreement with the Grand River Ry., that further pavement work involving an additional \$75,000 expenditure, will be undertaken.

Building permits to the value of \$40,700 were issued in Regina during the month of March, making a total of \$87,400 for the first three months of the year. Last year the total for January, February and March was \$446,500, but of this figure \$438,000 was for a warehouse for the T. Eaton Co.

At a recent meeting of the Winnipeg Board of Trade, Mr. N. T. MacMillan, speaking on the housing question, stated that Winnipeg needed 10,000 homes of the cottage and small bungalow type. He advocated the giving of the city's share of the Federal housing loan direct to the returned soldiers.

The council of Brant county, Ont., proposes construction work this season on either the Paris or the Burford road, whichever is not used as the route of the provincial highway, and a permanent road will be laid from Brantford to Waterford. The suburban area around Brantford is also to be improved.

A proposal has been made by men of the building trades' unions in Regina to eliminate the contractor in the undertaking of building and to erect anything from a shack to a big block for anyone in the city. In this way they propose to do away with the contractor's profits and reduce the cost of building.

The Essex Border Utilities Commission is having a by-law prepared for submission to the ratepayers, which provides for the taking over of the plants of the Windsor Water Board and the Walkerville Water Company for the supply of water to the five border municipalities—Windsor, Walkerville, Ford, Sandwich and Ojibway.

Work on the proposed bridge over the Mississippi River in Fitzroy township, County of Carleton, Ont., is to be started in June, the county council having let the contract to the Ontario Bridge Co., at \$55,500. The structure will be of steel on concrete abutments. Messrs. Byrne & Patterson, of Ottawa, are engineers for the county and will be in charge of the work.

It is reported that there is some opposition from Western members of parliament to the Dominion Government making grants for the construction of roads in Ontario and Eastern Canada. To offset this opposition, a number of Ontario municipalities are said to be organizing a scheme to have a big deputation go to Ottawa and place their views on the matter very definitely before the Government.

According to the announcement of Mr. Grant Hall, vice-president of the C.P.R., preparations are being rapidly completed to enable the company to undertake its construction

and betterment programme as soon as the frost and snow are sufficiently dispersed to make work possible. A considerable amount of ballasting is to be done in the West this year, but very little steel will be required as there are no large bridges contemplated.

The Canadian National Railway Board is granting requests for several improvements on the Niagara, St. Catharines & Toronto Ry., including the relaying of several miles of track within the limits of St. Catharines, with new pavement between the rails, entire new overhead work on the local line between that city and Thorold and the enlarging and transforming of Lakeside Park, Port Dalhousie, into a pleasure resort, with a new bathing house.

The department of public works of the province of New Brunswick proposes to continue on an extensive scale its policy of replacing wooden bridges with permanent concrete structures. A bill was recently introduced in the Legislature by Hon. Mr. Venoit, authorizing a debenture issue of \$600,000 for this purpose. The permanent bridges now under construction, he stated, would cost \$474,000, and those still to be undertaken will cost \$523,000, according to present estimates.

A delegation representing the Regina Builders' Exchange recently waited on the Provincial Government of Saskatchewan with the proposal that all contractors in the province be registered with the department of public works and that only contractors so registered be allowed to construct public or municipal works. Hon. A. P. McNab, Minister of Public Works, and Premier Martin, who received the delegation, replied that such a measure would require legislation after due consideration and did not give definite assurance as to whether action would be taken. The Builders' Exchange representatives were D. McKay, E. E. Poole and Wm. A. Wilson.

A deputation from Kent county, Ont., recently waited on Hon. F. B. Carvell, Minister of Public Works, urging that the Government renew dredging work on the Chenail Ecarte running into the Sydenham River. The Federal authorities, a number of years ago, dredged out the channel, but during the spring thaw the adjacent farm land is inundated. The Minister promised careful consideration of the request. The deputation also sought an amendment to the Indian Act, permitting municipalities undertaking drainage schemes to carry such works through Indian reservations. Under the present provisions this is not possible. Improvements were also urged for Rondeau harbor.

Personals

Alcide Chausse, architect, has removed his offices from No. 367 Beaver Hall Square, to No. 73 East Notre Dame Street, Montreal.

Mr. G. C. McDowell has been appointed city engineer of Fredericton, N. B. For some time Mr. McDowell has been town engineer of Truro, N. S.

Mr. B. F. Lamson, of the Welland Ship Canal engineering staff, has been appointed as assistant city engineer of St. Catharines, Ont., succeeding D. H. Fleming, who has become city engineer of Owen Sound.

H. W. Appleton, formerly with the Robert W. Hunt Company, and recently works manager Toronto Plate Glass Importing Co., has joined the staff of Burns & Roberts, Ltd., railway and contractors' equipment, Toronto.

Mr. C. O. Stillman, formerly vice-president of the Imperial Oil Co., has been elected to the presidency of that corporation, succeeding the late Hon. W. J. Hanna, whose death occurred recently. The vacancy on the board has been filled by the election of Mr. Alexander Murray McQueen,

who, since 1916, has been one of the senior officials of the company.

Lieut. M. B. Watson, M.A.Sc., C.E., M.E., has been recommended by the industrial advisory committee of the Board of Education for the position of Director of Engineering at the Central Technical School in Toronto. Lieut. Watson has served overseas. There were twenty-six other applicants for the position.

The committees recently appointed by the American Railway Engineering Association, head office in Chicago, included the name of Mr. J. R. W. Ambrose, chief engineer of the Toronto Terminals Railway Co., as chairman of the Roadway Committee and vice-president of the Standardization Committee. The work of both these committees is of a very important nature.

Lieut.-Col. Blair Ripley, D.S.O., who commanded the 1st Canadian Railways Troops overseas, arrived home last week. Prior to the war Col. Ripley was well-known as engineer of grade separation for the C.P.R., and he will resume this position after a brief vacation. The value of his services at the front have been recognized by the award of the D.S.O., as well as the mention of his name in dispatches on two occasions.

Mr. C. S. Ogilvie has been appointed assistant engineer, Ottawa division, Grand Trunk Railway system, in succession to Mr. H. Mowat, assigned to other duties. Mr. Ogilvie was formerly assistant engineer of the Grand Trunk at Belleville, and went overseas with the first contingent of the Canadian Expeditionary Force in the 13th Royal Highlanders. He was a prisoner in Germany for more than three years, being released after the signing of the armistice.

Announcement has been made of a number of new appointments on the staff at the works of the Dominion Steel Corporation. F. E. Lucas has been appointed Economy Engineer; A. L. Reading superintendent of the rail mill, and W. Buckley, assistant superintendent; W. Walshaw, roll designer; C. C. Graves, superintendent of blooming mill; S. Green, superintendent of the night mills. All of the above have been on the staff of the company seven years or more.

Obituary

Mr. Euclide A. Jacques, contractor, of Windsor, Ont., died recently. He was 60 years of age.

Mr. Donald MacDonald MacLeod who, in the early days, did considerable business as a contractor in the city of Toronto and the vicinity, died recently at the advanced age of 89 years. Mr. MacLeod retired from business about fifteen years ago and spent his declining years in Toronto.

Mr. G. H. Garden, who was well known in Canada in connection with railroad location work, died recently at Rouse's Point, N. Y. Mr. Garden first entered upon engineering work at the early age of sixteen years as an assistant to his father, who was a land surveyor. At twenty he was appointed assistant engineer on location of the I. C. R., at Newcastle, N. B. He was in charge of part of the location of the Crow's Nest Pass division of the C. P. R. in British Columbia and was in charge of location and construction on the Quebec & Lake St. John Railway, now part of the Canadian National Rys. He also supervised the location and construction of the greater part of the C. P. R. Laurentian Division, and from 1898 to 1901 was chief engineer of the Alberta Railway & Coal Co. at Lethbridge, Alta. For two years he was in charge of location of part of the Transcontinental Railway, and just previous to his retirement in 1914 superintended the locating of a large part of the C. P. R. Montreal-Toronto line. Mr. Garden was a charter member of Engineering Institute of Canada, and also a member of the Engineers' Club of Montreal.

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Our Duty to Returned Technical Men

IN previous issues we have described the establishment of clearing houses for returned technical and semi-technical men in Toronto and elsewhere and it is interesting to follow the results of this scheme. It will be recalled that information regarding returning men is gathered during the return journey; also that employers, or probable employers, of technical men were advised by letter and through the trade and daily press, of the existence of these offices, so that they could get in touch with the men at these points, or file copies of their requirements with the secretaries.

The Toronto office has been doing most valuable work during the past month, but the stage has now been reached when more technical men are applying than there are positions for. Approximately 35 per cent of the men making application have been placed in suitable positions and we might say, in passing, that this is one of the big advantages of the whole scheme, in that the bureau offices are in charge of skilled technical men who are careful to size up the possibilities of each man and fit him into the work for which he is specially equipped both in experience and training.

We are advised that at the present moment there

are about 120 men, for the most part of wide experience, who are open for engagement—these including seven accountants; twenty clerks; ten general construction men, from superintendents down; six chemists; twenty-five engineers; fifteen salesmen; ten surveyors; eight draftsmen and eighteen classed under "general" but including some very excellent material. We are advised that this list includes men who were formerly drawing salaries at high as \$5,000, so that all grades are available.

Employers of labor who may be in need of any of the men listed above or who know of positions which any of these men might profitably fill, are asked to communicate with Major Galbraith, or Lieutenant Rutherford, at 43 King Street, West, Toronto. We must not forget that the placing of these men in positions as good, or practically as good, as they left, is a duty we owe them.

Start at the Bottom When Organizing

AN organization, like a house, must be reared from the foundation up. It must have a substantial basic structure upon which to expand and become augmented. The trouble with most organizations in the past has been that they started at the top and worked down. Such associations have failed so often, and indeed must always fail for they are organized on a fundamentally wrong basis. They never stood because there was no foundation for them to stand on. The old cry of "let's organize" was simply trying to build a house by placing the roof first.

It is in the matter of a sound structure that the scheme of organization for the construction and building industries illustrated in the Contract Record of April 9th, page 329, derives its greatest merit. And being fundamentally solid, it answers all arguments. There is none of the tail wagging the dog about it—nothing but a reasonable, sensible, equitable and applicable scheme for securing unity, co-operation and strength among the construction interests of the Dominion.

Unwieldiness is, perhaps, the greatest evil of existing associations. Organizers try to get everybody of like interests together in a great convention that, when it meets, after trying to gather together representatives from a country 3,000 miles long, accomplishes nothing because it is unmanageable and because a condensed expression of opinion is impossible to secure. The executive attempt to build up a vast body, the individual members of which are amenable only to the whole without being locally grouped to care for localized needs.

The feature of the scheme referred to is that there is room for everybody and everybody has room without cumbersome results. Local builders' exchanges form the basis of the scheme. They are the backbone of the structure and through their appointed representatives a provincial organization is built up—a council or executive which will deal with the matters of provincial wide interests and consult with the provincial government in cases of necessity in the same manner as the local builders' exchanges consult with the municipal governments. Each province will be thus organized and represented by small councils, which being appointed representatives of the local exchanges are

able to act for them and venture opinions on their behalf.

In a similar way, a Dominion executive or council is composed of appointees from the provincial councils, empowered to consider problems of Dominion importance and to act with the Ottawa government when legislative matters are under discussion. The provincial councils and the Dominion councils need not meet frequently, indeed frequent meetings are inadvisable, but they are ready to offer a response to any call for their services.

An examination of this scheme cannot fail to indicate its simplicity. There is nothing involved about it; no waste effort; no unwieldy bodies to manipulate. It offers, further, plenty of room for expansion, for the reception of new exchanges at any time without any disruption or overlapping. Indeed it is fundamentally sound, for it starts at the bottom and works upwards.

Much Work Contemplated

THE building work which has lately been let in Montreal is mainly of a small character. Contracts for a very fine church at Lachine, for a large school, and for an apartment house to cost about \$500,000, are the most recent important jobs. The bulk of the work consists of additions to factories, new residences, and several small garages. The Government is inviting bids on the excavations and foundations of the addition to the Montreal Customs House. Several local contractors tendered on the military educational building at Kingston, but they all had their deposits returned. Several schools are to be built in the province.

Supply houses state that inquiries are coming in more freely, and it remains to be seen whether the buildings will materialize. There is a lot of work in the contemplation stage, but the high cost has proved, in the past, a bar to many schemes going ahead. It is in this connection that the Montreal Association of Building and Contracting Industries is working with a view to seeing whether the price of certain supplies cannot be reduced. Some supply men declare that this is not possible—take bricks as an example—while others admit that there is a possibility of smaller prices, provided that the manufacturers will co-operate.

Competitive Plans for Regina War Memorial

Further details of the competition for the plans of the proposed war memorial museum at Regina are available. Mr. Septimus Warwick, architect, Montreal, and Professor R. Traquair, professor of architecture at McGill University, have been appointed assessors in the competition. Among the architects invited to compete are Brown & Vallancé, E. & W. S. Maxwell, and Nobbs & Hyde, all of Montreal. Unsuccessful competitors will receive an honorarium of \$1,000 each. All drawings are to be delivered to the Deputy Minister of Public Works on or before July 7th, and the assessors will come to a decision within 21 days of that time.

MacKinnon Steel Co. Limited, Sherbrooke, Que., are starting the erection of two large tower derricks with 90 ft. booms, all steelwork for which has been fabricated by them, for the Davie Shipbuilding & Repairing Company, Lauzon, Que. This company has also recently completed a 70 ft. x 480 ft. crane runway for the same company.

Reconstruction of Roads to Cope With Motor Traffic

The committee of the American Road Builders' Association on "Reconstruction of Narrow Roadways of Trunk Highways with Adequate Foundations and Widths for Motor Truck Traffic" in presenting a progress report considered the following sub-divisions of this topic most profitable for discussion:

- (1) Width—(a) of the pavement, (b) of the shoulders.
- (2) Drainage—(a) surface, (b) sub-surface.
- (3) Foundations—(a) of new construction, (b) of previous construction.
- (4) Pavement surfaces.
- (5) Desirability of maintaining traffic during construction.
- (6) Economic improvement of line and grade.

Width.—The Committee recommends that the paved surface of the roadway on trunk highways should be at least 20 feet in width. For each additional line of traffic nine feet more should be added. The committee recommends that the minimum width of the shoulder be five feet.

Drainage.—The committee recommends that the present drainage systems be examined and placed in such condition that they will function properly. Such additions should be made as are necessary to keep the subgrade dry.

Foundations.—Where of new construction the committee recommends that all foundations be of concrete. Where present pavement can be utilized the committee recommends that the widening be of the same kind of construction as the portion to be utilized. While the committee have under consideration the bituminous macadam foundation, no definite conclusions have been formed as yet.

The committee has purposely refrained from recommending a thickness for the different types of foundations because they are aware that they lack specific data upon the kind and character of traffic to be put upon them. Nor have they any reliable information in regard to the destruction of different kinds of pavements by impact.

Pavement Surfaces.—It is recommended that pavements on trunk line highways be of concrete, bricks, wood block, stone block or bituminous concrete (of the mixed type).

Desirability of Maintaining Traffic During Construction.—The committee recommends that wherever possible, traffic should be maintained especially where the alternative is indirect or inadequate detours. This can be accomplished in some cases by carrying the traffic along the side of the roadway; in others it has been found possible to construct the pavement one-half at a time. It is suggested that these methods be given consideration even though they involve a greater immediate cost than would the closing of the roadway. It is certain that better and surer provision must be made for the maintenance of traffic.

Economic Improvement of Line and Grade.—A thorough study of line and grade is recommended in order that sharp turns and steep grades may be eliminated at the time of reconstruction.

This report is presented as one of progress only.

Improvement of Vancouver Harbor

Engineer Makes Recommendations for Immediate Development of Port — \$12,000,000 Will Construct First Unit

WITH the idea of developing the port of Vancouver and improving its facilities so as to make it worthy of its geographical and economic position at the Pacific terminus of the great Canadian transcontinental railroads and in proximity to the magnificent resources of the West, the Dominion Government has been seeking expert advice in regard to improvements that might be effected to make it a great shipping centre. In 1911, Mr. A. D. Swan, C.E., of Montreal, was instructed by the Department of Public Works to examine into and report on the general conditions and existing facilities of Vancouver harbor and propose such schemes for the future development of the port as seem suitable to promote its growth and otherwise best serve the interest of the port and of the country.

Mr. Swan's studies on this occasion were embodied in a report submitted in 1912 in which were included a number of recommendations, work upon which has, however, been carried out to only a limited extent. As certain facilities were urgently required, Mr. Swan was authorized in the fall of 1918 to make further investigations and report on the immediate and urgent requirements. The recommendations of the engineer as a result of these considerations, are embodied in a report just submitted to the Minister of Marine and Fisheries. In the last issue of the Contract Record reference was made to the main points which the engineer urged as necessary. Since publishing the article referred to, the report has been made public and a further review is made herewith.

One cannot be otherwise than optimistic, the report states, as to the future trade of the port if modern facilities and proper equipment for handling cargoes are provided at the earliest possible date, so that it may not be handicapped by allowing rival American ports to get so far ahead that it would be difficult for Vancouver to gain what she has lost through lack of foresight and preparation. Judging from the great ports of Europe, those that are doing the biggest business and doing it most efficiently, are the ports that have kept their facilities ahead of actual requirements, and great development has invariably been followed by increase of trade and population.

In considering the probable future traffic at the port, it is somewhat difficult to arrive at sound conclusions as to what immediate development is necessary. In ordinary circumstances, one would naturally turn to the trade of the port for the last three or four years, but owing to war conditions, and the fact that enormous supplies have been shipped to Russia, China and Japan, and other centres through Vancouver, which might, in ordinary peace times, be shipped by other routes, the engineer concluded that he must not base any recommendations on the recent trade returns, as they were abnormal. At his request, the Canadian Pacific Railway prepared statements as to their total import, export, and coastwise traffic at the port from 1913 to 1918, which was as follows:

1914 over 1913	21% decrease
1915 " 1913	3% "

1916 over 1913	112% increase
1917 " 1913	164% "
1918 " 1913	105% "

Future Increase in Traffic

From the rapidly increasing business with the East, he thinks it most probable that there will be a very considerable future increase in traffic over the year 1913. Mr. Swan interviewed personally each and all of the large shippers now exporting from or importing into Vancouver, and obtained a statement as to what additional wharfage they were prepared to make use of if it was provided and properly equipped at reasonable charges, so that such recommendations as he makes are based practically on actual requests for immediate facilities, and if a comprehensive plan of the whole general scheme is now approved, the future accommodation can be increased from time to time as trade and commerce expands and the necessity for such increase in wharfage arises.

Owing to the lack of wharf accommodation and facilities at Vancouver, the total charges for wharf handling and storage amounts to practically \$4.95 per ton for thirty days as compared with \$1.60 at New York and \$2.30 at Seattle. The reason given for the charges at Vancouver being so high was on account of the limited accommodation and lack of wharf facilities. At New Orleans the insurance on cotton is 0.30 cents per \$100; at the C. P. R. wharfage at Vancouver the insurance is \$1.50 to \$2.35 per \$100. One firm wrote that it costs importers 0.10 cents per 100 pounds more for charges into the port of Vancouver than into Seattle, as it takes steamers so long to unload at Vancouver. The same firm states that there is no space available on the wharves at Vancouver for storing import or export cargo.

In addition to the present traffic handled at the harbour, there appears every reason to suppose that business which is now being handled through American ports and of which a considerable quantity is ultimately for Canada, can be attracted to Vancouver if proper facilities and plant are provided. Reference is made more particularly to oil storage tanks for non-inflammable oil, for the handling of which traffic there are no facilities at present, although there have been actual requests for same. The import of vegetable oils in 1917 from the Orient, through Pacific Coast ports, is reported to have been to the value of over \$70,000,000, three-quarters of which, it is estimated, was discharged at Seattle. In March, 1918, Seattle's tanking capacity was four and one-half million gallons, and it was expected this would be increased by the end of the year to six million gallons. Several of the largest firms in the oil business consider this oil trade will not only stay, but rapidly increase, and the demand for such oils in Canada is already great. Evidence of this was given by the fact that three or four of the largest companies approached the Harbour Commissioners of Vancouver with pressing requests for storage and handling accommodation at the port.

Another source of business for the handling of which there are no facilities at present, and which is

the most prominent natural industry of the district, is the exportation of lumber. The object of a lumber-distributing wharf is to enable ships to take full cargoes of lumber which has been assembled from many interior mills.

Apparently, the want of economical facilities for assembling shipments and the cost of handling lumber and shingles from the smaller mills, has made it impossible, in the past, for any except the larger mills to participate in export business.

The lumber interests informed the engineer that the establishing of an assembling yard with facilities for handling the products of the mills, would be the greatest boon that could be offered to the lumber industry, as it would enable them to operate at times when the interior market was buying lightly, and that if there were facilities for storing their lumber at a wharf they would be in a position to raise money on this lumber when required, if it was stored on the harbour property.

Recommendations

In view of the foregoing, Mr. Swan recommended that a comprehensive scheme for wharf areas, railway terminals, roads, sheds, warehouses, and freight-handling facilities in general, should be designed on a broad basis and constructed by degrees as required, and that the following should be commenced as soon as possible as they are required now.

- (1) A booming ground for lumber should be provided in English bay.
- (2) A timber export wharf provided in one or other of the alternative positions referred to hereafter.
- (3) A harbour terminal railway.
- (4) Provision for six new deep-water berths or wharves at once.
- (5) Mechanical equipment provided at the new government wharf, and other wharves when constructed.
- (6) Equipment for non-inflammable oil storage in some suitable site.
- (7) Provision of a fire tug, fitted with powerful crane, which tug shall be used as an auxiliary car ferry to serve immediate needs to North Vancouver.
- (8) Removal of present C. P. R. bridge across False Creek, and, if necessary, construct new bridge in suitable location.
- (10) Provision of suitable landing facilities at North Vancouver for auxiliary car ferry with railway connections.
- (11) Second Narrows bridge should be constructed as part of the complete scheme if not immediately, at an early date.
- (12) Dry dock to be constructed by government, if not arranged for by private interests at early date.

Booming Ground

In Vancouver harbour, owing to the prevalence of the teredo (a worm which very rapidly destroys timber) lumber booms must be stored on tide flat land, that is, between high and low water, so that as the tide recedes, the lumber is exposed to the sun and air, which destroy the worm.

As lumber is one of the most important local industries, and the accommodation requested seemed reasonable, and the provision of same would only entail very moderate expense, the engineer recommends this facility be provided.

The site for the booming ground which he suggests is on the south side of English Bay, on the fore-

shore opposite a golf course, which land is owned by the Admiralty. In order to protect the lumber booms, he suggests that a short breakwater or rubble mound should be constructed running out from the shore for a distance of probably fifteen hundred feet, or a little farther, if necessary. This small breakwater would form a protection from any seas which might otherwise disturb the lumber, and at the head of the breakwater should be constructed a landing place or small wharf where the tug attending the timber boom, could be moored. In addition to the rubble mound, a few small clusters of piles to link up the boom, will be required.

Timber Export Wharf

"A timber export wharf," Mr. Swan states, "seems to me to be not only advisable, but almost essential, as there is practically no provision at present at Vancouver for handling this business, and it is firmly believed that an immense volume of trade by the smaller class of vessels, a large number of which have been built during the war period, would be immediately secured, not only for trade to Great Britain and to ports on the Pacific such as South America, but in all probability to the eastern ports of Canada, by way of the Panama canal.

"Regarding the approximate amount of export business available for shipment, if proper facilities were provided, the delegation of lumbermen whom I met felt confident that the first year's shipment would easily reach twenty-five million feet of timber, and the second year, probably fifty million feet. This quantity would only mean about 15 per cent of the present amount being shipped from Washington, Oregon, and British Columbia, and they thought it only reasonable to assume that in the next five years, the total amount shipped from the Pacific coast, would reach a billion feet. In that case Vancouver would still only be shipping 10 per cent of the entire amount.

"If it is decided to establish a wharf for this purpose, there must be in close proximity, a considerable area of land for timber storage.

Equipment of Wharf

"The wharf itself should be provided with good railway facilities and equipped with a large gantry crane of a lifting capacity of probably about five tons, designed not only to handle lumber but to facilitate the transshipment of structural steel, machinery or other heavy equipment. This gantry would be able to travel over the entire lumber storage areas so that lumber received either by rail or barge, may be stored on the wharf. On part of the wharf, a dry-lumber shed, say approximately five hundred feet long and about eighty feet wide or thereabouts, of comparatively inexpensive construction, open at the sides and with a roof only and fitted with an overhead travelling crane of a span about eighty feet, to travel from one end of the shed to the other. There should, in addition, be a locomotive crane of say ten or fifteen-ton capacity for rapid handling of the lumber, and other general purposes. This crane when not in use on the timber wharf, could, of course, be run in a few minutes, to any other part of the harbour, when required."

In regard to a suitable site for this wharf, the engineer has considered several alternatives, and concludes that the advantages seem to be with a site at Kitsilano or one at North Vancouver in front of the Indian Reserve.

The economical advantages of publicly administered

switching facilities in the immediate vicinity of dock wharves have been amply demonstrated in the case of Montreal harbour, where the different railway companies, at points designated in the harbour, hand over their cars, properly marshalled, to the Harbour Commissioners, who place them where desired at the freight sheds, grain elevators and other places for loading and unloading, and the cost of removing freight to and from the cars has been reduced about 50 per cent. Such a harbour railway not only affords facilities for transshipping freight and switching cars from one railway line to another and from railway to wharf and vice versa, but also connects with the different industries located along the harbour front to which are shunted all manner of raw materials, supplies and manufactured goods.

From information gained at Vancouver, and from the numerous complaints of excessive charges and serious delays in handling traffic there, Mr. Swan states that a harbour terminal railway would overcome many of the present disadvantages and prove a decided attraction to the port, and he recommends that the necessary property should be acquired and the work proceeded with. A harbour terminal railway has been already approved by the Privy Council, dated March 31st, 1916. The estimated cost of the right of way and construction through sundry properties, from the Kitsilano Indian reserve to the Heaps Mill property on Burrard Inlet, being estimated therein at \$1,552,861, but it has since been estimated that this amount might easily be considerably reduced and still be quite sufficient and that much of the property could be exchanged leaving only \$600,000 to be provided in cash. The acquisition and negotiations in connection with the purchase of the necessary property for the construction of this terminal railway, if approved, will require very considerable study and negotiations, more particularly, as in all probability, a considerable amount of the property might be acquired through exchange of property already belonging to the Harbour Commissioners. This question has been preliminarily investigated in an exhaustive manner, by Mr. Cartwright, Civil Engineer, Vancouver, on behalf of the Vancouver Harbour Commissioners but the subject is one which would require further study, and it is believed that much of the necessary negotiations in connection therewith could be carried out and settled amicably as many of the various proprietors seem anxious to be able to get increased railway facilities.

Fire Tug and Mechanical Equipment

It is feasible to design and provide a tug boat fitted with fire fighting appliances which could be used in conjunction with a large scow to form an auxiliary car ferry service between Vancouver and North Vancouver, which, owing to the present inadequate facilities is evidently urgently required. As this boat would never be outside of the limits of the harbour, in the event of fire she could immediately be disconnected from the scow forming the car accommodation and proceed with all haste to the fire. In addition it is suggested that this fire tug should be provided with a fairly powerful crane which would be available for lifting heavy goods, or such operations as might be required within the precincts of the harbour; in addition the tug should have towing facilities so that she could be hired when otherwise free for small tows within the harbour limits; such a vessel from its combination of uses, would prove an asset to the port.

"My object in recommending the provision of mechanical equipment," reports Mr. Swan, "is to reduce the cost of raw materials and the finished article to the consumer. Reduction in the cost of transport between the source of supply and the manufacturer or consumer is the primary object of such appliances. Rapid loading and discharging of vessels is an important factor in freight charges. It is obvious that the port which gives vessels the most rapid dispatch will become popular with the ship owners and favorably influence freights to that particular port.

"In my opinion it is only by such appliances that one can insure rapid discharge of the ship, keep down port charges, and thus make the port financially sound and attractive to both ship owners and traders. Incidentally such equipment should not be called "labor-saving appliances," but "labor-aiding appliances." If the port is not sufficiently provided with well designed sheds and ample quay space as well as appliances for the handling and sorting of merchandise of all description, loss and extra expense will be incurred.

"I will not enter into detail as to the class or amount of equipment which should be provided at the moment. Generally speaking, electric cranes are most favorably looked upon as they can be utilized for so many different purposes.

"Electric trucks for rapid handling inside sheds and other equipment have been proved to be very profitable investments. I therefore recommend that the Dominion Government wharf on Burrard Inlet, which has no mechanical equipment, should be equipped with cranes and other necessary machines as soon as possible, and that in designing the new wharves and harbor sheds recommended herein provision should be made for their proper mechanical equipment."

Second Narrows Bridge

"When I prepared my former report on Vancouver harbor, dated 29th March, 1912," declares Mr. Swan, "plans were then being prepared for a bridge across Burrard Inlet at the Second Narrows, which scheme was being promoted by a private company. The object was to give access for railway, vehicular, and passenger service between Vancouver city and North Vancouver. Complete plans were prepared by one of the best known engineering firms in London, England. Tenders were invited, but for one reason or another the work was not proceeded with. The bridge in question, as designed, was about sixty-four feet in width, giving one single railway track, two tramway tracks, two roadways, and a footpath, and the lowest tender for complete bridge was \$2,443,097.

"Having in view the immediate construction of that bridge when I made my report, I recommended that one pier should be built at North Vancouver, as good railway facilities would be provided by means of the new bridge. The bridge has not been constructed, and until arrangements are made for its construction I do not see that very extensive wharf accommodation should be provided at North Vancouver, as owing to the present inadequate railway facilities, any wharf accommodation given would be very expensive to work.

"In view of the fact that there are most excellent sites for wharf accommodation at North Vancouver which can be acquired at reasonable rates, and owing to the very large traffic now existing between North Vancouver and Vancouver city, I am strongly of opinion that the Second Narrows bridge should be pro-

ceeded with and the railway line extended from the site of the bridge down to North Vancouver city, and connected on to the present terminal of the Pacific Great Eastern Ry. The width of Burrard Inlet at the Second Narrows at low water level is only about 950 feet, and I venture to think I could design a very much less elaborate bridge than that previously proposed, giving quite sufficient accommodation for the traffic which is likely to use the bridge for many years to come.

"I suggest that a bridge about fifty-three feet wide should be provided, which would give one railway track, one tram line, one roadway, and one footpath. This bridge would only be about eleven feet narrower than that formerly proposed.

"I have gone into this matter very carefully with one of the largest bridge construction companies in Canada, and they agree with me that such a bridge as I suggest would be perfectly adequate for the purpose intended, and could be constructed complete for the sum of about \$1,650,000, or thereabouts.

"If this bridge is proceeded with it would form a most important link in the railway service and would connect up all the existing industries on the north shore, and no doubt, many more industries would immediately locate there if they were provided with railway facilities. The tram line across the bridge would, no doubt, command a considerable rental from the tramway company. The bridge I suggest would have a very large opening span so as not to interfere with shipping passing to and from Port Moody."

Equipment for Non-Inflammable Oil Storage

As already mentioned, application has been made to the Harbour Commissioners from some of the largest firms in the oil business for suitable facilities and tanks to permit of the importation of large quantities of non-inflammable oil into the ports of Vancouver, and in view of this, immediate provision of equipment is recommended for handling this oil business either at the new government wharf or at such other site as may be considered convenient and immediately available.

New Deep Water Berths

A previous consideration of the probable future traffic at the port gives reasons for recommending the immediate necessity of providing additional deep water berthage, part of which is based on actual requests from some of the largest shipping companies at Vancouver, and only to a small extent on problematical business, and bearing in mind some reasonable accommodation which will no doubt be required for the new Canadian Government steamship business.

In view of these requests it appears reasonable to immediately commence the provision of some five or six berths for deep water shipping. The question of the most suitable site for deep water berthage is a matter requiring much serious study and consideration as there are several alternative sites, each of which have many advantages. The Burrard Inlet site and the Kitsilano site at the mouth of False Creek are the only locations considered in the report.

Site at Burrard Inlet

Burrard Inlet affords a magnificent natural deep water harbor, very well protected, and approached from English Bay and the Pacific Ocean by the First Narrows, the water way of which is now about one thousand feet wide by thirty-two feet deep at low water.

In the past the First Narrows had a somewhat objectionable current, but this has been reduced by the dredging operations carried on during the last few years; there is, however, considerable prevalence of fog at the narrows which seems to hang there rather longer than at other places in the vicinity. The main water frontage of the city of Vancouver on Burrard Inlet has been acquired or is being occupied by the Canadian Pacific Railway for a length of 8,225 feet. The rights of the Canadian Pacific Railway to occupy part of this frontage is disputed by the Vancouver Harbor Commissioners. There still remain very good sites for harbour development on the main water front east of the C. P. R. frontage extending from the British Columbia Mills Timber and Trading Company's property to the E. H. Heaps property east of the new government dock or a total frontage of about 7,000 feet, 1,200 feet of which is owned and occupied by a pier belonging to the Great Northern Railway Company. This site if developed regardless of cost, would provide twenty-four berths between the British Columbia Mills and the new government wharf and three berths to the east of the new government wharf.

In order to develop this site a considerable length of water-front property would have to be acquired, although it might only be decided to proceed with one or more piers meantime, as land area for railway sidings must be provided even although only one pier was built. In order to have the necessary space for traffic the shore wharf from the Canadian Pacific Railway should be not less than about 400 to 500 feet in width, and the piers jutting into the inlet for a length of about 1,250 feet, and a width of about 300 feet giving accommodation for four berths to each pier the depth of water at the outer end of the pier would be considerable, and the harbour bottom in many places has a depth of soft mud about twenty-five feet deep, which would necessitate either this mud being removed and replaced with solid filling or the foundation carried down through the mud by cylinders, or some such method of construction to the hard bottom underlying the soft mud.

Desirable Depth of Water

One point to be borne in mind in considering the location of the new deep water berths is the depth of water available so as to permit of the most desirable developments in ship dimension. Just previous to the commencement of the war this was a subject which was beginning to receive a good deal of attention, but during the last four years it has, of course, been a question of building ships in the quickest way possible to suit the present depth of our harbours and docks. Having peace conditions in view, however, the ports making provision in the construction of new works for vessels of greater depth than those regularly in use now will reap material benefit, and if the restriction imposed by the depth of water in harbour and docks was removed, vessels of much greater depth would be immediately constructed.

From the studies and opinions of some of the most eminent shipbuilding and naval architects of this day, cargoes and passengers could be carried at probably somewhere about half the cost if our harbours were deepened so as to allow a very considerable increase in the draught of the vessels.

It is suggested that a few berths at the outer ends of the piers where the water is naturally deeper should be provided to say, 45 feet, and that the berths at the inner end could be considerably shallower. The site

in question at Burrard Inlet rather lends itself to this increased depth, but in order to make any use of it it would mean the dredging to a very much greater depth than at present of the First Narrows, where there is only 32 feet at low water. Otherwise deep-draught vessels would have to wait for the tide before they could get into Burrard Inlet. There is already established on this foreshore two most important plants doing considerable business; one is the British Columbia Sugar Refinery Company, and the other is P. Burns and Company's Abattoir, but probably some amicable arrangement could be made with these as well as with some of the other proprietors, as the provision of wharfage accommodation in the immediate vicinity of their industries would be a considerable asset. When the necessary foreshore land for the new government wharf was expropriated, the price was fixed by the court at \$1,200 per front foot, so that assuming this rate had to be paid for the necessary property to be acquired from the British Columbia Mills to Heap property, and making allowance for buildings, the amount to be paid for the foreshore land would be somewhat in the vicinity of \$9,000,000. The price paid for the land and damages, etc., for the one new government wharf at Burrard Inlet was \$564,640, equal to approximately \$41,809 per acre, and the cost of the available wharfage excluding sheds, equipment, etc., is about \$1,353 per lineal foot. For the sake of comparison with the Kitsilano scheme hereafter described, if 12,000 lineal feet of available wharfage at Burrard Inlet is taken the area of land provided, including the surface area of the piers, would be about 67 acres.

Kitsilano

There is an excellent site for the construction of deep-water wharfage at Kitsilano at the mouth of False Creek, which is shown on the plans as an alternative to development at Burrard Inlet. The land at Kitsilano was an Indian reserve, and was expropriated by the Vancouver Harbour Commissioners on September 7th, 1916. It is assumed, however, for the purposes of the report, that the price will be agreed upon at \$750,000, or approximately \$10,714 per acre for 70.3 acres. There is a Y centre at the Kitsilano Indian reserve belonging to the Canadian Pacific Railway, approximately about seven acres in extent, which it would probably be advisable to acquire, and if the same rate per acre was paid for this land the amount would be in the vicinity of \$70,000. However, this amount is not included at the moment, as the matter would be one of adjustment or probable exchange with the Canadian Pacific Railway for other property.

Accommodation for 21 Steamers

The scheme shown for the development at Kitsilano when completed would provide berthage accommodation for twenty-one steamers. The entrance to the various basins is excellent. The railway accommodation is also very good and in proportion to berthage accommodation, and a large area of land is available on the Kitsilano Indian reserve for warehouses or other industrial developments. In order to protect this site, as part of the scheme a sea wall or break-water would be constructed, but as shown on the plans the inside of this sea wall would be available as a shipping berth.

The total cost of the complete development at Kitsilano, including land, dredging, and embanking, quay walls, sea walls, lighthouse, two-storey reinforced concrete sheds, railway sidings, roads, lighting, equipment,

and allowing the problematical amount of \$100,000 for probable rock excavation, and including engineering would be \$18,750,000 for the whole scheme complete. For the purpose of comparing the cost of this scheme with the Burrard Inlet development the cost of the wharves and land all complete, but without sheds or equipment, etc., would be approximately \$10,750,000, providing 12,000 lineal feet of available quay space equal to \$895 per feet of quaying, as compared with the cost of the new government wharf at Burrard Inlet of \$2,164,640 for the bare wharfage and land, excluding shed equipment and providing 1,600 lineal feet of berthage equal to \$1,353 per lineal feet of available quay space. Assuming that the same amount of sheds and equipment was provided at either of the alternative sites, the cost of the wharfage and land at Kitsilano would be over 60 per cent cheaper than a similar amount of wharfage at Burrard Inlet. As a comparison with those figures the cost of the new wharfage at Victoria, B. C., including the break-water, but excluding cost of land, was approximately \$1,364 per foot of available quay.

Cost of Kitsilano Scheme

At Kitsilano the area of the Indian reserve is approximately 70 acres, in addition to which there would be provided the quay space on the shore wharf and new piers of an additional 68 acres, together making 138 acres of land, or practically 100 per cent more land available for development at Kitsilano than there would be at Burrard Inlet. If the price tendered by the Harbour Commissioners of \$750,000 for the Indian reserve is finally approved, this would equal approximately \$10,714 per acre, as compared with approximately \$41,809 per acre for the government wharf land. The plans show accommodation at Kitsilano for twenty-one steamers, but it is not suggested for a moment that all this accommodation should be provided now, as the general scheme permits of the construction in units, and if this site is finally approved it is suggested that the above quay which is 2,700 feet long and the first small pier 500 feet long, or a total of 3,200 feet would probably be ample to commence with. Taking the proportionate rate for the whole scheme this would provide six berths at an approximate cost of \$4,500,000 complete, including land, sheds, railways sidings, and equipment. The foregoing estimates are all based on 1914 prices, with 25 per cent added thereto.

This shore quay at the mouth of False Creek is, without doubt, much the cheapest site where deep water accommodation can be provided, with the least possible delay. Briefly, in comparing the two sites, the Burrard Inlet scheme is a little nearer the commercial centre of the city than Kitsilano. The depth of water available at Burrard Inlet is governed by the amount of dredging to be done in the future at the First Narrows, which is to-day 32 feet at low water. If additional wharfage is provided at Burrard Inlet it should be in as close proximity as possible to the new government wharf, so as to be able to make further use of the new grain elevator, which has been constructed there, and which, from its location, only provides at present loading facilities at two berths, whereas, if the conveyor system is extended it could load grain at any number of berths within reasonable distance. Otherwise the one site does not seem to have many more advantages than the other with the all-important exception that the Kitsilano could be constructed at about 60 per cent less cost than Burrard Inlet, and at the

same time provide about 100 per cent more land for industrial development.

Dockage Facilities for Passenger and Other Traffic

The Executive of the Canadian National Railways ask that docking facilities should be provided, and suggests False Creek as being the most advantageous location for this traffic. The report therefore suggests berthage accommodation on Granville Island, on property belonging to the Vancouver Harbour Commissioners, below Granville Street bridge. As already stated, it is highly desirable that this part of Granville Island should be rectified and it is accordingly suggested that the desirable rectification could be given effect to in conjunction with the provision of the berthage accommodation for the National Railways. As an alternative to this site good accommodation could be provided at the head of False Creek, adjoining Main Street which would be in very close proximity to the passenger terminals of the Canadian National Railways and the Great Northern Railway.

Estimated Cost

Approximate preliminary estimate of cost of first unit of proposed works, and lands necessary to be acquired:

1. Booming ground for lumber should be provided in English bay, say	\$ 50,000.00
2. Timber export wharf provided in one or other of the alternative positions referred to	250,000.00
3. A harbor terminal railway	675,000.00
4. Provision for six new deep-water berths or wharves at once	4,500,000.00
5. Mechanical equipment provided at the new government wharf, and other wharves when constructed	160,000.00
6. Equipment for non-inflammable oil storage in some suitable site	25,000.00
7. Provision of a fire tug fitted with powerful crane which tug shall be used as an auxiliary car ferry to serve immediate needs to North Vancouver	150,000.00
8. Provision of dockage facilities for passenger and other traffic in connection with Canadian National Railways	200,000.00
9. Removal of present C.P.R. bridge across False creek and, if necessary, construct new bridge in suitable location	
10. Provision of suitable landing facilities at North Vancouver for auxiliary car ferry with railway connections	50,000.00
11. Second Narrows bridge should be constructed as part of the complete scheme, if not immediately, at an early date	Entered below
12. Dry dock to be constructed by Government, if not arranged for by private interests at an early date	" "
	\$6,000,000.00
Land at Kitsilano, say	750,000.00
	\$6,750,000.00
Second Narrow bridge at early date	1,650,000.00
	\$8,400,000.00
Add 10 per cent. contingencies and engineering	840,000.00
Total	\$9,240,000.00
If dry dock is constructed by Government, add	3,500,000.00
First unit—Grand total	\$12,740,000.00

Dry Dock

A dry dock is recommended for the port of Vancouver at the earliest possible moment. Such a dock

would not only make the port much more attractive to ship owners but should prove a sound commercial success. During the past few years two or three different private interests proposed constructing a dry dock at Vancouver but owing to the war were unable to complete their financial arrangements.

If private interests apply for the subsidy, and proceed with such work, it will not, of course, be necessary for the government to take further action; but if they fail to complete their negotiations then the government itself should construct a dry dock and equip same complete with caissons, pumping plant, and keel blocks at a total cost which would not exceed \$3,500,000.

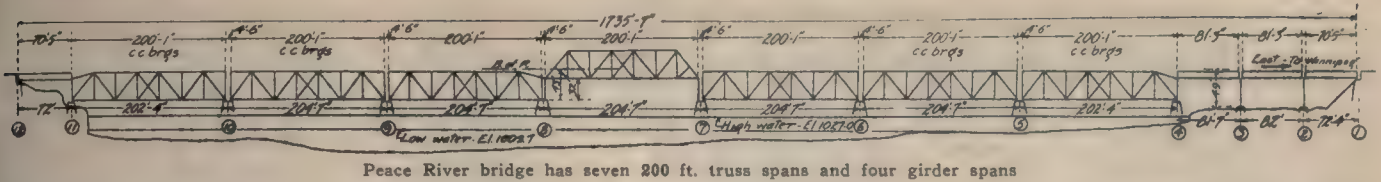
Previous Recommendations

The former report of Mr. Swan presented in 1912 after a study of the harbor, extending from Dec. 12, 1911, to Jan. 10, 1912, urged a continuation of widening the First Narrows; declared Burrard Inlet was the natural deep water harbor for ocean shipping; advised construction of additional wharfage on the harbor front from the C. P. R. pier; recommended additional wharfage east and west of the sugar refinery; advocated wharfage provision on the north shore of the Inlet; declared False Creek should be dredged and used as the centre of coastwise traffic; recommended the filling in of the upper end of False Creek to be used as a central railway terminal of all railway lines that may enter Vancouver, and advised dredging of the North Arm of the Fraser to permit light-draft craft using it.

A considerable portion of the present report is taken up with a summary of the extent to which these former recommendations have been carried out. The work of widening the First Narrows has been proceeded with and the Narrows dredged to a width of about 100 ft. with 32 ft. depth at low water. This work is considered to be a great improvement, but has not yet been completed to the extent of the former recommendations. The new government pier has been constructed in the vicinity of the sugar refinery but nothing has been done toward the provision of wharfage at North Vancouver. The report declares that conditions have considerably changed at this location, so that there is no use providing wharfage until railway facilities are provided.

A considerable amount of dredging has been carried out at False Creek, so as to give 20 ft. at low water from the C.P.R. bridge upwards. The upper end of False Creek has been filled in and a considerable portion is now occupied by the Canadian Northern Railway, and the Great Northern Railway. The engineer's recommendation regarding the alteration of the C.P.R. bridge across False Creek has not been given effect to, although continuous renewals are being constantly made. The bridge, in its present condition and position, is a serious obstruction to traffic, and it is recommended that it might, with advantage, be moved up in much closer proximity to the Granville Street bridge.

An industrial area, known as Granville Island, has been constructed by the Harbor Commissioners for the purpose of providing industrial land at a reasonably cheap rate with facilities for shipping either by land or water. Thirty-five acres have been reclaimed, of which about one-third has already been leased. This work is largely in keeping with Mr. Swan's previous recommendations.



Peace River bridge has seven 200 ft. truss spans and four girder spans

Completion of Long Bridge Over Peace River

Description of Superstructure on 1735-Foot Bridge, Comprising 2200 Tons of Steel, Erected Under Difficult Conditions

THE first bridge over the Peace River at Peace River Landing, in Alberta, has recently been completed. The structure, with a total length of 1,735 ft., provides railroad communication to the rich Peace River basin. In an article in the Contract Record of January 2, 1918, page 3, a complete description of the substructure design and methods of construction was given, and this present article supplements the former article by providing a brief outline of the steel superstructure. The drawing, showing the elevation, gives a good idea of the make-up of the bridge.

As will be seen from the elevation, there are seven spans 200 ft. 1 in. long, centre to centre of bearings, of which six are deck spans. In the south approach there are three girder spans, with two steel bents about 35 ft. high, and in the north approach, one girder span, resting upon the steel of one of the deck spans, at one end and on the abutment at the other. The total weight of the steel work in the bridge is 2,200 tons, and the weight of one of the typical truss spans is 275 tons.

The trusses of the truss spans are set 18 ft. 3 in. apart, centre to centre, 36 ft. 0 in. deep, centre to centre of chords, and the bridge is designed to carry a single track, which provides for two 360,050 pound locomotives, followed by a train weighing 4,750 pounds per lineal foot. The future addition of a 12 ft. highway on each side is made possible in the design of the present bridge. At the present time highway traffic is cared for by means of timber flooring, laid down on the railway ties, every fourth tie being made long enough to support a sidewalk and a hand rail on each side.

The erection of the steel work started about the last of May, 1918, and was completed about the middle of October, 1918. Pile falsework was used throughout, and the piles were driven by means of the same 12-ton derrick car equipped with a 62 ft. boom, as was also used to erect the steel work itself. For some two months the erection was delayed on account of flood conditions in the river, when a large amount of drift timber, together with high water conditions, made it extremely difficult to maintain the falsework. A boom was swung part way across the river on the up-stream side of the bridge to hold back the drift, but in spite of this protection, timber still came through, going under the boom. It will be of interest to note that the ferry boat in service at Peace River Landing broke away from her moorings a number of times during this period of high water.

At one time two bents of the false-work of the

second spans were carried out, but the energy and skill of the erector prevented any steel from being lost. A portion of the steel work of the bridge in process of erection was supported cantilever fashion from the steel work of the adjoining span. The season is very short at this point and the arrival of winter weather extremely early, and the completion of this entire crossing before the winter weather, in spite of the severe high water conditions encountered in the summer season, was extremely creditable.

The Peace River bridge carries the Edmonton, Dunvegan & British Columbia Railway over the Peace River at Peace River Landing, in Alberta. The steel work was designed, fabricated and erected by The Canadian Bridge Company, of Walkerville, Ontario, under the direction of Mr. W. R. Smith, general manager and chief engineer of the Edmonton, Dunvegan and B. C. Ry. Mr. C. M. Goodrich, designing engineer of the Canadian Bridge Co., gave the information in this article.

Steel for Paravanes

ONE of the Navy's secrets that has been disclosed since the cessation of hostilities is the use made of otters or Paravanes (called P.V.'s for short) in enabling ships to pass through mine-fields with almost complete immunity. These devices were towed in pairs, one on either side, from a point as low down as possible on the ship's bows, in such a way that they were not in the ship's wake but stood out obliquely away from the hull. When a mine-moor-ing cable was encountered it was forcibly deflected from the ship and along the whole length of the towing rope until it came to the Paravane itself. Here it encountered scissors or shear blades which, although it was made of steel 1½ in. in diameter, cut it as easily as a pair of scissors cuts a piece of string. These blades, which were only 10½ in. long, with a section about 1½ in. wide by ½ in. thick, had to be made of exceedingly fine and strong steel, and after long and extensive tests by the Admiralty the "Triumph Superb" high-speed steel manufactured by Messrs. J. J. Saville and Company, Limited, of Sheffield, was exclusively adopted for them. The whole efficacy of the Paravanes, so far as mines were concerned, depended on these cutter-blades, for if through becoming blunt or breaking they failed to cut the cable the mine would remain submerged and dangerous, whereas if it was released and rose to the surface it could be immediately detected and destroyed.

Some Kent County Culverts

By Geo. A. Farnsworth*

THREE typical concrete culverts or small bridges of Kent County, Ontario, are illustrated herewith. They are all located in the township of Howard, and were constructed by the author. Bridge No. 1, built in 1915, provides a 16-foot roadway and a 15-foot waterway. The footings, 2 ft. x 2 ft., are in hard clay, and the side walls are 12 in. thick, of 1:6 mix, reinforced with $\frac{1}{2}$ -in. square bars 1 foot apart each way. The upright bars in the side walls protrude about six inches to allow the cross rods in the top to hook on. The top of the bridge is 10 in. thick, of 1:4 mix, reinforced with 1 in. rods about 1 ft. apart, with barbed wire strung between the rods about 2 in. apart. The railing is $1\frac{1}{2}$ in. gas pipe set in stubs of 2 in. pipe which were placed at the time of construction.

The bridge in the middle illustration has an 18 ft. roadway with a 15 ft. waterway. The footings, 1 ft. x



Three typical bridges in Kent County, Ont.

5 ft., are in quicksand. The side walls, of 1:6 mix, are 18 in. thick at the bottom, tapering to 12 in. at the top. They are reinforced in the same manner as the previously described bridge. The top is 10 in. thick, of 1:4 mix, and has seven 9 in. I-beams equally spaced

*Contractor, Ridgeway, Ont.

and No. 9 wire fence across the beams. The railing is $1\frac{1}{2}$ in. pipe with union couplings.

The third culvert, built in 1918, has a 4-foot waterway and a 20-foot roadway. The footings, 18 in. x 18 in., are in hard clay. The sidewalls and wings are 12 in. thick with the reinforcement as in the other bridges. The top, of 1:4 mix, is 8 in. thick and reinforced with $\frac{1}{2}$ in. square bars 6 in. apart, with No. 9 wire fence, 2 ply, on top of the bars. The long wing wall, noted in the illustration, is necessary at a sharp bend of the waterway at the bridge.

\$2,420,000 for New Public Works in Manitoba

IN his budget speech in the legislature the Hon. Edward Brown, provincial treasurer for the Province of Manitoba, estimated the expenditures for the current year at \$8,377,100. He also estimated the total revenue for the current year at \$8,450,400, leaving an estimated surplus of \$73,000.

The following are the capital expenditures estimated by the provincial treasurer as being necessary during the year.

New Parliament Buildings	\$1,000,000
Furnishings and fittings	200,000
Grounds	150,000
Manitoba school for the deaf, preliminary estimate	100,000
Brandon asylum	150,000
Selkirk asylum	50,000
Home for incurables	25,000
Pyscopathic building	20,000
Morden land titles office	10,000
Provincial buildings and grounds	81,277
Rural Credits Association capital	10,000
Manitoba Farm Loans' Association	100,000
Lignite Utilization Board	100,000
Ninette sanatorium	100,000
Reimbursement of revenue for capital	323,722
Total	\$2,420,000

The Greater Winnipeg Water District Board is taking steps to enter the sand and gravel business, and is seeking reduced transfer charges for its cars over the C. P. R. and Canadian Government Railways. Commissioner Waugh stated at a recent meeting that the board could supply from the pits along the line of the aqueduct all the trap-rock and crushed granite to Winnipeg that would be required for years, and that gravel could be laid down in the city at \$2.25 per yard as against the present price of \$2.79. Private sand and gravel concerns are strongly protesting against the board's action.

The Philip Carey Co., Ltd., Toronto, have given the agency for their products for the provinces of Manitoba, Saskatchewan and Alberta to the Building Products & Coal Co., corner of Victoria and Notre Dame Ave., East, Winnipeg. This latter firm recently changed its name, being formerly known as the Thomson McDougall Company.

Metal workers at four big iron works in the city of Calgary, Alta, have been locked out, due to their establishing an eight-hour day on their own initiative. Their hours had been nine. They are also asking increase in wages from 70 to 85 cents per hour.

Guelph, Ont., Takes Step to Organize Builders

Representatives from Toronto and Provincial Organizations Show Where Co-operation Through Organization Will Benefit Industry

THE organization campaign initiated by Mr. H. Elgie, president of the Provincial Builders' & Supply Association of Ontario, is showing results. The men of the building industries in the city of Guelph, which is reputed to be one of the liveliest places of its size in the Province, are determined to sustain that reputation, and in accordance with Mr. Elgie's suggestion, a meeting was called, on the evening of Tuesday, the 15th, at which the question of forming a branch of the Provincial Association was discussed and decided upon: There exists in Guelph at the present time a Master Carpenters' Association, which, being wide awake to the advantages of organization, called the men of the other trades together, and invited Mr. Elgie to come up and tell them all about his proposition. He was "on the job," and also brought along with him Mr. Geo. Oakley. If there had been any opposition to the co-operative idea, this battery would assuredly have been heavy enough to remove it, for their ammunition is of the best. But the Guelph men are sufficiently progressive to realize that the conditions in the building industry—and indeed in every other industry—at the present time, make organization and co-operation really essential, not only to their own individual welfare and the welfare of the whole industry, but also to the prosperity of Canada as a nation. The old idea that "competition is the life of trade" has some truth in it, but many have been misled by it, and they have resorted to "cut-throat" and unfair competition, which is the death of trade. The new idea which has been indisputably proven under the test of war, is that "co-operation is the life of the nation," and likewise that "co-operation is the life of trade." This is the principle that the building and construction men throughout Canada must act upon, and Guelph and other progressive towns and cities are setting an example which, it is to be hoped, will be universally followed.

Comprehensive Organization Wanted

The meeting in Guelph was thoroughly representative. There were carpenters, masons, plumbers, painters, cement, sheet metal and building supply men present. Mr. G. A. Scroggie, the President of the Master Carpenters' Association, was elected to the chair. He pointed out that this organization, which had been formed some eight or nine months ago, had resulted very beneficially for the men of this branch of the industry, and that for this reason they were anxious to have a comprehensive association formed, taking in all the trades, so that everyone might share in the advantages. He then called upon Mr. Oakley to explain to the meeting what the provincial plan of organization was and how they might enter upon it.

Have You an Edge on the Other Fellow?

Referring to the tardiness which had been shown by building men in getting together, Mr. Oakley pointed out that all had the idea that they had a little "edge" on the other fellow, and for that reason they had hesitated to meet and discuss business with each other. "However," he said, "everybody now knows

that there is something lacking in the industry. We take a job and we believe we make money on it; we take another and we are not so sure about the profits, and finally at the end of the year we find we haven't as much money as the year before. On account of these conditions, the men of the industry are beginning to feel that if we don't organize now, we are going to finish our business without making anything out of it."

The speaker referred to the Ottawa conference, at which the Association of Canadian Building & Construction Industries had been formed, and, said he, when you get men from all over the Dominion together saying that they want organization, surely it is a sign that organization is needed. He pointed out the field of the Dominion organization and the provincial organization. The Dominion organization would deal with the Dominion Government, and would take up any questions which affected the industry throughout the country. In like manner the provincial organization dealt with the provincial government, and handled any questions which affected the trade throughout the Province. Then came the local organization, and from it the most direct benefits were felt. Organization meant better prices and better workmanship.

Connecting Links from Your Own Shop to the Dominion Organization

Mr. Oakley then directed attention to the chart (reproduced in our issue of April 9), which had been distributed by Mr. Elgie, illustrating the connecting links from the individual to the Dominion Association. First, he pointed out, we have our troubles in our own shop. If we feel we have a difficulty in common with other shops, we take it up with our section of the local exchange. If it is a matter the section cannot deal with, it is passed on to the exchange. Perhaps they can deal with it, but if not it is passed on to the provincial organization, which will deal with it, or if necessary pass it on to the Dominion association.

A few years ago, the speaker pointed out, they had a good illustration of what the support of the province, through the provincial association, can effect. In the first place, some Toronto men had gone to the Ontario Government as members of the local exchange, requesting certain changes in the Lien Law. Their suggestions were listened to attentively, and they thought they would be acted upon, but after waiting a year, nothing was done. They then took the matter up with the provincial association and went, as representatives of that association, to the government. The result was that now there was a revision of the Lien Law before the Government. When they got the concerted weight of the provincial association behind them, then the authorities began to sit up and take notice.

Mutual Confidence Must be Developed

"When you want to go into an organization of this kind, you must realize that there are other men in the business who know as much, or nearly as much, as

yourself. You have got to get mutual confidence, and when you get that conditions will at once improve. Perhaps you have labor problems to deal with right now. I believe that the workmen have a perfect right to band together to better their condition, and so also should the employers in the industry. Not only would they get closer co-operation between themselves, but also with the workmen. The labor people realize the benefits of getting together. I presume they are pretty strong in Guelph, and if they are not now, it will only be a short time till they will be, and if you don't get a proper organization of your own you will be at the mercy of the labor unions."

The chairman thanked Mr. Oakley for his address, and, referring to the labor question, pointed out that the carpenters in Guelph were demanding an increase from 45 to 60 cents an hour. His sympathies were with the workmen, but he thought this was a little too much of a jump all at once, and if there was any way in which organization could help them, he was sure they would be glad to take advantage of it.

Association Helps to Remove Antagonism

Mr. Elgie was next called upon to speak. The advantages of organization, he said, were indisputable. When he first started in the contracting business, he went to the exchange and paid his money, and since he had never regretted it. The social benefits were very considerable. He remembered the time when he himself, when he went to figure on a job, if he saw a competitor coming, would slip away, recognizing him as an enemy, when he should have considered him a brother in the business. Meeting one another in the Exchange brought about the removal of this antagonistic spirit.

In regard to the Lien Law, the labor party wanted to get a bill through the house which would allow them to collect their wages over the heads of everybody else, even including the mortgagees. "Can you conceive," the speaker asked, "of any business man loaning money under these conditions? Can you conceive the position in which it would place the building business?"

Organization Needed to Combat Unfair Demands of Other Bodies

The lumber merchants, some time ago, tried to get through a bill whereby they would have sixty days to put a lien on and hold back 33 1/3 instead of 20 per cent. It was under such circumstances as these that it was necessary for the provincial association to take action. He noticed that when the government ministers heard that they were representing Ontario, it was an altogether different matter from when they came to them merely as Toronto representatives. A meeting had recently been called in regard to the Lien Law and a new law was going to be enacted. The Government was appointing a commission to take the matter up with all the interested bodies in Ontario, and the men of Guelph would surely want to share in it. Toronto, when alone, got very little consideration.

Then there was the Compensation Act. The labor party wanted to have 100 per cent. of their wages paid when they were sick, instead of 55 per cent., as well as their doctor's bill. "Have you," asked the speaker, "any mechanics in Guelph that will go to work if they can stay at home and have a good time with full wages and the doctor attending them?"

In regard to the merit and demerit clauses in the act, Mr. Elgie said he had at first favored them, but

the hardship wrought by this provision in the case of another member of the association had caused him to change his mind. This member had a workman who fell from a box he was standing on, due to a rush of blood to his head, and afterwards died. As a result the employer had to pay heavy damages, although he was in no way responsible for the accident.

Here, then, lay the advantages of organization that they could get together and discuss their troubles and find out just how any measure was working—whether it was beneficial or otherwise.

Little Disagreements Don't Hurt

"The reason we don't get together," said Mr. Elgie, "is that we have not faith in each other. I have felt sometimes that I was the only honest man in the business. But the fact is you can get together at your monthly meetings and help one another. The association may not work harmoniously at the start, until you begin to understand each other better, but you will find that after a little disagreement you will be better off."

The speaker referred to the principle of keeping Canadian work in the hands of Canadians. This was something that might be assisted by their association, and the Americans would not resent it, but would rather admire them for it, as it was something the Americans themselves believed in. There was also the matter of trade discounts which he believed the contractors should have advantage of, and they might effect this through co-operation in their organization. The social side of the question, too, was worth considering. If the Guelph men joined in, they would be free when they came to Toronto to go to the exchange and have a chat or do business, and vice versa.

Mr. Scroggie suggested that following the addresses, those present would probably wish to ask a number of questions regarding the formation and operation of the organization and invited them to do so.

Mr. Elgie, in answer to a question, said the fee in the Toronto Exchange was \$20, and for affiliation with the Provincial Association there was a per capita tax of \$1.00. In Indianapolis, he pointed out, that they collected dues on the basis of one-half of one per cent. of the value of work carried out, \$50 being the minimum. In that exchange each member was bonded for \$1,000 and the bricklayers would not work for any man who did not belong to it. He gave the wages paid in Toronto as follows: Plasterers, 70c; plasterers' laborers, 50c; tinsmiths, 60c; stonecutters, 65c (asking 75c); painters, 55c; bricklayers, 72c; laborers, 45c; concreters, 55c; navvies, 40c. San Francisco paid \$9 for an eight-hour day for bricklayers.

You Get Out of the Organization in Proportion to What You Put in

In reply to a question from Mr. Shepherd as to fees in smaller places, Mr. Oakley stated that in London the fee was \$25, and in Chatham the same. A great deal would depend on conditions, but if it was worth while to come in, \$25 should not be too much to ask. There was also the question of graduating the fees according to the amount of work done.

Mr. Elgie pointed out that value got out of the organization would be in proportion to the amount paid in. Anything he had sacrificed for the Builders' Exchange he had been repaid for many times over.

There was considerable discussion on open price methods of tendering, and Mr. Elgie pointed out that in Indianapolis the arrangement was that on the day

before the bids closed, the bidders came and handed a copy of their tender to the secretary and the figures were put down on a blackboard. Each of them thus sees his competitors' figures, and if he has made a mistake or thinks he is low, he can withdraw his bid or go up to the top of the list, but he cannot reduce.

Contractors Not Honest with Themselves

Mr. Mahoney expressed the opinion that in the past contractors had been honest with the public, but they had not been honest with themselves, and had not got a fair return for the work they did. In his own trade, plumbing, he knew of one man who retired and he died.

Mr. Oakley thought that there had been some unfairness to the public in taking work too low, and then giving a poorer class of job than the owner expected.

Mr. Butler believed that most of the dishonesty was the fault of owners who came to contractor, telling him he was a little high and beating him down to a lower figure. If the contractor wanted to be honest with himself and with the public he should stick to his price when he has submitted it.

Stick to Your Figure

Mr. Oakley agreed that in this way they would get rid of 90 per cent. of the ills of the industry.

In reply to a question from Mr. Howell, Mr. Elgie stated that in Toronto the trade was asking a discount of 10 per cent. on supplies.

Mr. Cowan asked how the supply men might change their prices to the trade without making the public think they were being imposed upon.

Mr. Elgie said it was simply a question of establishing a standard price and then allowing a discount.

In order to get a definite expression of opinion on the matter of organization, on motion of Mr. Mahoney, seconded by Mr. Cowan, the various trades got together to discuss the matter of organization amongst themselves and report back.

Mr. Reynolds, as one of the painters, said that while he was not in a position to speak for the whole of the trade, he himself was in hearty accord with the movement and believed the others would join in if it once got started.

Mr. Mahoney, speaking as a representative of the plumbing business, said he would like to talk it over with other members of the trade and report at an adjourned meeting.

Mr. Zieman, a sheet metal man, took a similar view.

The bricklayer contractors present believed if a meeting of their trade were called they would be only too glad to join in.

Mr. Stewart, as one of the supply men, was heartily in favor of the organization. He believed there was never a time it was more needed.

Organization Would Settle Question of Prices and Discounts

Mr. Howell, in the hardware business, thought that any difficulties that might arise in the matter of prices and discounts, if brought before an association, could be got over. But in this connection, where a dealer sold an article to a contractor, allowing him a discount, he did not think it was right that the contractor should go to his client and say, "let me buy this for you, I can get it cheaper." The client often happened to be a customer of the dealer, and, in a case of this kind, imagined he was being held up by the latter.

Mr. Reynolds did not think that the fee should be made too high, or some of the smaller men might think the association was being made exclusive.

Organization Committee Appointed

Mr. Shepherd moved, and Mr. Cowan seconded, that action be taken for the purpose of organization at the present meeting, and a show of hands indicated that those present were unanimously in favor of the movement. Finally it was decided, on motion of Mr. Mahoney, seconded by Mr. Cowan, that the carpenters' association, together with one representative from each of the other trades, be appointed as an organization committee, the carpenters association to select the representatives, and that another meeting be held on April 25.

Mr. Mahoney moved a vote of thanks to Messrs. Elgie and Oakley and the representative of the Contract Record for coming to Guelph to help forward the work of organization.

The following is a list of those present at the meeting: W. A. Cowan, V. Shepherd, W. Douglas, R. Prior, G. Ibbotson, T. Gordon, H. Handbridge, J. A. Scott, E. M. Stewart, W. G. Howell, J. Gowdy, H. Mahoney, G. Griner, H. Bates, W. Stuart, R. Williams, F. R. Johnston, J. Gould, C. Butler, A. Dennis, A. Bennett, A. Reynolds, F. Zeiman, J. J. Mahoney, W. Harris, H. Pass, H. Occomore.

Victoria Wants to Spend Million on Roads

Applications for the construction of macadam roads aggregating \$1,000,000 in cost are before the city council of Victoria, B. C. City Engineer F. M. Preston has presented a list of proposed trails that had been tabled by the 1918 council. He was instructed to investigate and inform the committee as soon as possible which roads appeared to be the most important.

Many contractors in Alberta claim that they are in a position to build irrigation works and take the Irrigation District bonds in payment.

Bid Prices on Regulating Valves

The following tenders were received for regulating valves in York Township, Frank Barber and R. O. Wynne-Roberts, Engineers.

	12-inch	16-inch	24-inch
Canadian Allis-Chalmers, Ross valves	\$ 607.50	\$1,093.40	\$1,745.00
Francis Hankin, Ross valves	750.00	1,300.00	2,025.00
Drummond McCall & Company, Blakeboro valve	*425.00	725.00	*1,600.00
Drummond McCall & Company, Golden-Anderson valve	1,075.00	1,900.00	
Drummond McCall & Company, Ross valve	630.00	1,130.00	1,860.00
Equipment Specialties Ltd., Davis valve	693.51	825.00	1,375.00
Equipment Specialties Ltd., Golden-Anderson valve	1,202.00	1,765.00	
Golden Anderson Company, own valves	714.50	1,259.60	2,783.00
John T. Farmer, Glenfield valves	565.00	900.00	1,832.00

*Tenders accepted.



Fig. 1—125,000 square feet of skylight on C. P. R. train sheds have not had a glass breakage in six years

New Type Skylight Saves Maintenance Expense

THE illustration shown herewith is that of the skylight on the Windsor Station, Montreal, of the Canadian Pacific Railway Company. This was put up in 1913, and our description of the building at that time made only brief mention of the skylight because it was then a new product and one that had not withstood the test of time. Now, however, after six years, the Canadian Pacific Railway Company's officials state that the skylight is in perfect condition and that, in the meantime, the cost of maintenance has been absolutely "nil."

This skylight, manufactured under the trade name of "Nonpareil," by the A. B. Ormsby Company, differs from other skylights on the market to-day in almost every feature, both as to the material used and as to methods of construction. The main bar of the skylight is constructed of 16 gauge material, formed as shown in the cut, Fig. 2. Over this is a second bar, the outer edges of which carry the lead glazing bar and the glass. This bar is constructed of 22 gauge material, and is riveted to the under bar. At intervals the upper bar is punched and the brass bolts put in for fastening the cap.

The skylight as constructed, is positively both water and air tight, and the bar is so arranged that even if any water were to leak in under the cap or condense on the inside of the glass, there are three gutters so placed as to catch and carry off any leakage of this kind. The gutter formed by the lower bar on each side is much wider than the gutter formed by the upper bar, and added to these two gutters there

is a third, that of the lead glazing bar, upon which the glass rests.

One of the most important features of the Nonpareil skylight is the fact that no material but metal and glass goes into its construction in any way whatever, and of these metal parts probably the most important is the lead glazing bar or cushion mentioned above. This cushion has parallel vertical holes that conform perfectly with the uneven surface of the glass and is detachable and reversible, which permits of its being applied after all the other work of constructing the skylight has been finished, excepting the glazing. This lead cushion carries the weight of the glass, and permits expansion and contraction sufficiently freely to prevent any breakage from this cause. Then, too, the bar cap is so constructed as to have on each edge a lead glazing strip, which, when the cap is tightened down, lies along the surface of the glass, and can be adjusted so as to give a water-tight finish.

At the end of each bar is riveted a curb clip, that, in addition to preventing the glass from slipping, holds the metal eaves in place in such a way as to allow for expansion and contraction, also closing the ends of the caps and preventing the entrance of water or air under the most trying conditions, such as a driving storm.

The bars are constructed from both galvanized steel and from galvanized steel coated with lead, the lead coating being done after the bar has been formed. This gives a product that is entirely immune from attack by acids, smoke or fumes of any kind. When the skylight is constructed of the lead coated bar with copper cap and copper trimmings, there should be no limit to the length of time that it will last.

Up to date a large area of these skylights has been erected in Canada. Among other contracts are the

following: Canadian Pacific Railway, train sheds, Montreal; Northern Electric Co., Limited, Montreal; Robert Reford building, Montreal; Abitibi Pulp & Paper Co., Limited, Iroquois Falls; Montreal Tramways Company, Montreal; Toronto Street Railway

be unlocked and the contents checked against the number of bags of cement used.

Another device that has been successful in securing better care of sacks on the job is a holder attached to the frame of the mixer near the loading hopper. As soon as sacks have been emptied they are piled in this holder until there are 50 of them, when they are tied in a bundle and laid away properly protected until shipment is to be made.

A sack bundling device which will satisfactorily meet all requirements can readily be made by the contractor. An accompanying sketch shows details of an inexpensive device of this kind. Fifty sacks are counted into the rack with two wires running under the pile and one long wire running lengthwise on top of it. One end of the steel bar is run through an eye bolt and attached to the other end to a hook. The two short wires are then tied over the sacks, thus doubling them over the long wire. The bundle is then released by withdrawing the bar, after which the long wire is

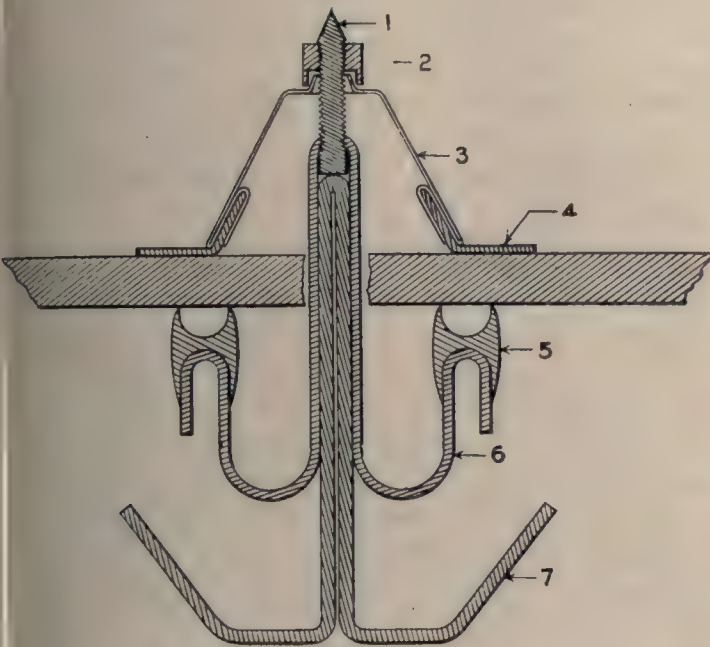


Fig. 2.

Skylight construction that makes provision for expansion and contraction

Co., Toronto; Registry Building, Toronto; Toronto Hydro-electric Commission. Of these, the largest is the C. P. R. train sheds, cut of which is shown in Fig. 1. The total glass area of the skylights on these sheds amounts to 125,000 square feet. These skylights have been in use now for nearly six years and during that time not one single light of glass has been replaced, nor has it been found that any of the glass has been broken through expansion and contraction. No complaint of leakage or from any other cause has been made by the C. P. R. since the skylights were installed.

Money Saved by Taking Care of Cement Sacks

MUCH of the contractor's profit can be swallowed up by careless handling of cement sacks. Any container worth 25 cents certainly deserves care, and provision should be made on every job to see that cement sacks are not abused but handled so they remain in good condition and hence returnable for credit.

When a car of cement is unloaded, the workmen should be cautioned to watch for torn sacks so that contents may be transferred to a good sack without waste of cement or further injury to the damaged sack. Cement sacks make convenient tool bags, knee pads, aprons, etc., but are not intended for such use and if so used, are almost certain to cost the contractor 25 cents for each of these misuses.

One method of caring for sacks on the job is to have alongside of the mixer a tight box with a locked lid, in which is a slit, through which the sacks can be shoved as fast as they are emptied and shaken out. At the end of the day, or oftener if necessary, this box should

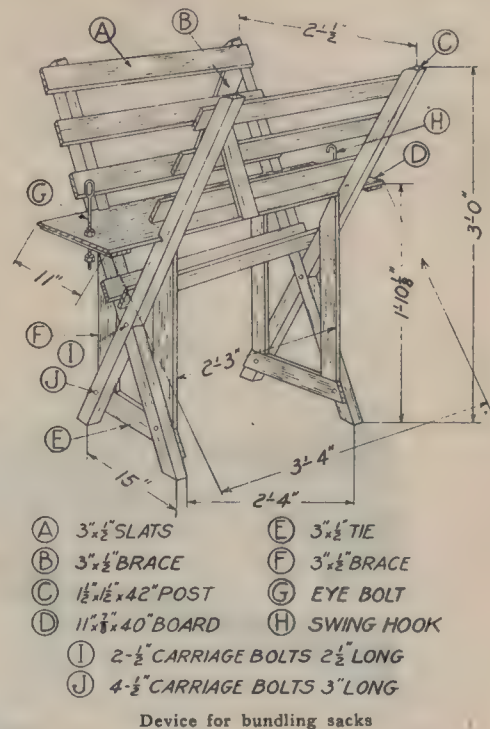
brought around the ends and a hitch taken with it around the other wires. The long wire is then brought around the middle of the sacks and tightly tied.—Concrete Highway Magazine.

Westmount Architectural Committee

The Westmount Council has appointed Messrs. Robert Findlay, D. H. Macfarlane, B. M. MacVicar, and A. Campbell Woods, as the architectural committee. These members will work in conjunction with the mayor, the general manager and the city engineer in connection with the passing of plans and the improvement of the city.

Montreal Building Permits

During the month of March the Montreal building permits totalled \$228,208, a decrease of \$13,392. For the first quarter of the year the value was \$440,102, an increase of \$5,287.



Device for bundling sacks

Concrete Colliers Built on Unit Principle

THE five reinforced concrete vessels shown in one of the illustrations below, reproduced from "The Engineer" form the first half of an order for ten 1,000 tons colliers placed by the Admiralty with Messrs. Christiani and Nielsen, 25 Victoria St., London, S.W. The vessels are 185 ft. long with a beam of 35 ft. and a depth of 18 ft., the hull being of the straight line type which, although having ship-shaped ends, is composed of straight lines in every vertical section. The vessels were built in a dry dock excavated inside the Port of London Authority area at Tilbury Dock, and the dry dock basin, which was made large enough to accommodate five vessels being built simultaneously, is connected with the Tilbury main dock by means of a 40 ft. wide canal, provided with reinforced concrete dock gates.

Excavation work on the site was commenced early in 1918, and the engraving above referred to represents the finished dry dock on January 26th, 1919, when the five hulls were ready for the floating, which event took place unofficially a few days later.

The vessels are built on the unit system according

to the patent of Mr. R. N. Stroyer, by which method of construction the sides are cast lying down horizontally and, when mature, are lifted into position by means of suitable tackle. The bottom is then cast and joined up to the sides, the joint in the latter only occurring where transverse bulkheads in the vessel necessitate a joint in any case. The stem and stern, where the curvature of the lines is too great to admit of this method of construction, are cast in the ordinary way in situ, but provision has been made for thickening the concrete skin of the vessel to 5 in., so as to be sure of a good casting in the vertical walls. In the sides and the bottom where the skin is cast horizontally, a thickness of $3\frac{1}{2}$ in. is considered to be sufficient.

The advantages claimed for this system of construction are first the saving effected in centering, inasmuch as all the outside mould and strutting for the bottom and the sides is dispensed with. Then it is pointed out that the placing of the reinforcement and the casting of the concrete for the sides is reduced to operations of great simplicity, while the surfaces of the sides can be made absolutely smooth without employing plastering or rendering, since the concrete itself can be worked up to a fine surface while still plastic. Then, again, it is claimed that the system permits of the very speedy construction of vessels, and it is asserted that the Tilbury yard has produced the largest number of vessels, having regard to its size, in a given

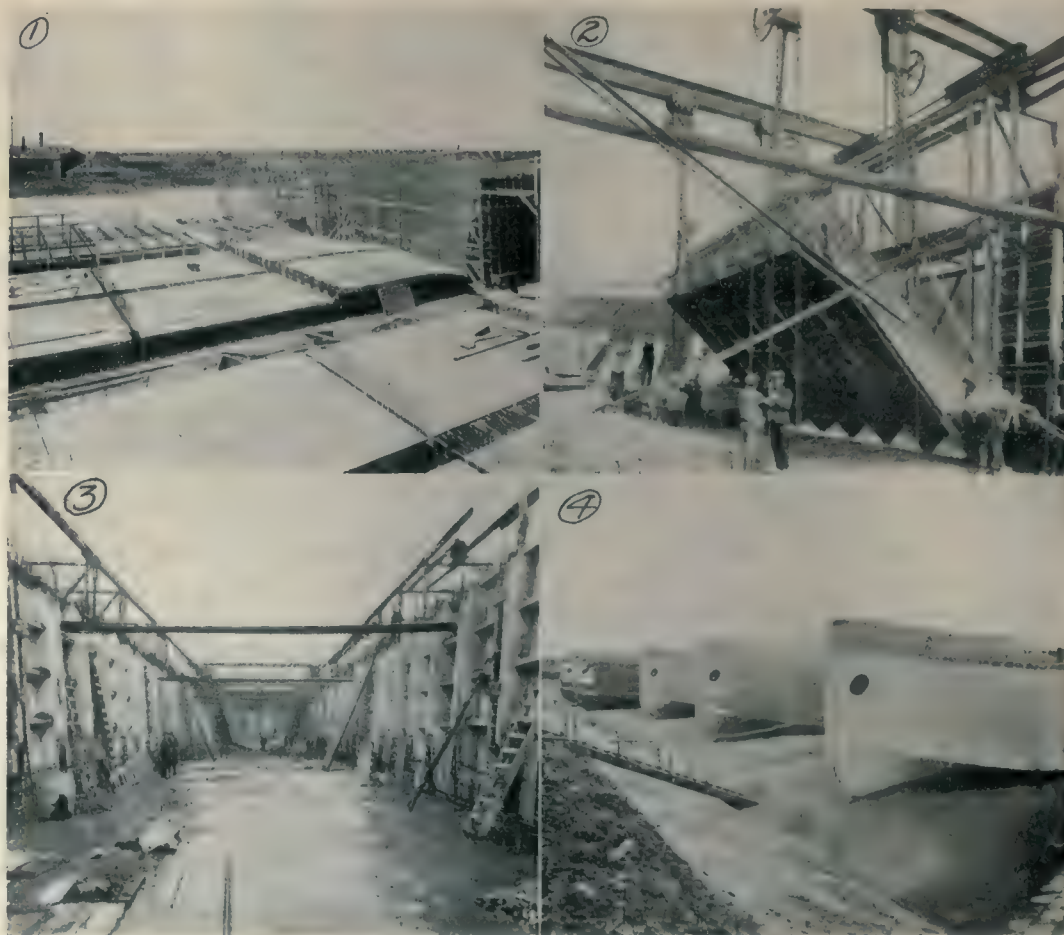


Fig. 1. Side slabs ready for lifting into position; Fig. 2. lifting side slab into position; Fig. 3. sides in position ready for floor reinforcement; Fig. 4. completed lighters in dock ready for floating

period of time, and that it is, at the same time, the cheapest of all the concrete shipbuilding yards in the country.

The other illustrations show the construction of the vessels in various stages, such as: The sides lying horizontally ready for lifting; the actual lifting of the side slabs; and the sides placed in position ready for the bottom of the vessel to be put in.

The outfit of the vessels consists of four Temperly transporters for handling the coal, with the necessary winches, a complete electric light plant for use when coaling at night, and the usual deck fittings, such as steam windlass, capstan, steering gear, etc., for which the steam is supplied by two large Cochran boilers, and recovered by means of a surface condensing plant.

Status of Guarantees on Pavements

Committee Makes Report on Purpose, Extent and Application of Guarantees on Life of Road Surfaces

IN view of the looseness with which the terms "guarantees" and "maintenance" are often applied to paving contracts, the committee on "Economic Status of Guarantees of Pavements on Roads and Streets" of the American Road Builders' Association, in reporting on this subject at the recent convention of the association made it clear that it believed the two terms should be regarded as separate and distinct, and that the guarantee period should not be longer than the reasonable life of the pavement without repairs, except those rendered necessary by reason of defective materials or workmanship or both.

This is in accord with numerous court decisions in connection with assessment work, and automatically settles the question of legality, and at the same time clearly indicates the maximum period which should be called for in a guarantee. The committee recommends that the maximum period should be fixed at five years. The report of this committee states further:

Three types of guarantees are in common use: (a) Bond, preferably from a surety company; (b) Retention by the municipality of a certain amount of cash; (c) Bond and retained percentage.

The intent of the guarantee is to guard against defects in material and workmanship and non-compliance with the specifications, but in many cases, defects may develop in the pavement or roadway which are due to other causes and conditions which may have been entirely outside of the scope of the contract.

Responsibility for Work

It is apparent, therefore, that the responsibility for a satisfactory and lasting pavement is shared by both the engineer and the contractor. With the engineer rests the responsibility of providing proper drainage and adequate foundations and the selection of a suitable type of pavement and the preparation of comprehensive plans and specifications. He must also provide such inspection as is necessary to insure strict compliance with the specifications. With the contractor rests the responsibility of carrying out in a satisfactory and workmanlike manner the plans and specifications and instructions of the engineer. The safeguarding of the public welfare lies, therefore, in the hands of the two parties above mentioned, with the following possible exceptions.

In a number of instances pavements have failed due to causes which may or may not have been controllable by the engineer or the contractor. Such causes are: Defective street railroad construction;

settlement of trenches for underground service pipes; improper system of cleaning the pavements; leaky gas or water mains. The engineer is directly responsible to his community, and if he is negligent or incompetent should, and presumably can, be removed. Generally speaking, the question of public welfare or economics in this connection is not directly involved in the guarantee clause of a contract except in those cases where an incompetent or negligent engineer has prepared faulty specifications and, as a consequence thereof, has asked a contractor to guarantee a pavement which is liable to fail through causes other than defective materials and workmanship.

Inspection Facilities

Assuming that the plans and specifications are entirely competent and proper, the next duty devolving upon the engineer is that of inspection, which includes testing of the materials to be used. This requires a laboratory equipped for physical and chemical testing and the services of some one who has made a specialty of testing paving materials, as such work does not come within the scope of an ordinary chemist. Larger municipalities often maintain their own laboratories and testing staff. Smaller municipalities may, and frequently do, avail themselves of consulting and testing experts, but a certain proportion of them do not and, on the contrary, permit their pavements to be laid with only such supervision and inspection as their engineers can personally give to the work, and in many instances these engineers are not well qualified in this particular line, and would gladly avail themselves of expert help were they permitted to do so.

In addition to the preliminary testing of materials, provision must be made for the inspection of the work as it progresses. Where the pavement is manufactured in a plant and then delivered to the street, inspection at both the plant and the street is essential. For example, in the case of a large asphalt plant where 200 or 300 batches of mixture are sent out daily, involving 600 to 900 separate weighings, a rigid inspection, such as would justify the total elimination of a guarantee clause, would require two inspectors. The preparation of the subgrade, the mixing and laying of the concrete base, and the laying of the wearing surface would similarly require two or three inspectors and these must all be trained men, not haphazard appointees.

From the standpoint of a municipal engineer this is a very serious problem. His reputation, as judged

by the lasting qualities of his pavements, might often rest in the hands of inspectors whose appointments and qualifications were entirely outside his control.

Difficulty of Securing Competent Inspection

It has been justly said that with competent inspection, guarantees could and should be entirely eliminated, but from an economic standpoint there remains the question of cost of sufficiently adequate inspection and the difficulty of securing it. The drawbacks and defects in the guarantee system are too well known to require elaborate discussion in this report, but it is a fact that present inspection systems have been devised and carried out with a view to providing reasonable (but not absolute) security, having in mind the certain or uncertain amount of additional protection accruing from the guarantee clause inserted in almost all paving contracts. If this is to be abolished the inspection must be made more rigid and therefore costly, and the lines must be drawn more tightly than heretofore, both as to materials and workmanship.

Engineering is not an exact science so that in all cases a certain factor of safety must be employed and there is no such thing as a hair line division between good and bad. When the results are guaranteed, even though the guarantee is far from perfect, it is human to require a somewhat lower factor of safety than would otherwise be insisted on. Where the contractor assumes no responsibility for his finished work, the inducement to slight it and thereby save money, is greatly increased and the inspecting force must be still more competent, vigilant and trustworthy than would otherwise be necessary.

Cost of Guarantee Bond

The cost of a guarantee bond to the average contractor does not exceed 1 per cent of the total cost of the contract. On a pavement costing \$3.00 per square yard this would amount to 3c per square yard, which would barely cover the increased cost of inspection above described, without taking into consideration at all the increased bidding price likely to result from increased severity of inspection. Assuming that the guarantee is only for the normal life of a pavement without repairs, there exists no legitimate reason for the contractor to increase his construction bid by more than the cost of his bond.

As between a reliable and established contractor and one who is lacking in experience, resources and equipment, it is easier and cheaper for the reliable contractor to secure his bond and this can only be regarded as a legitimate advantage to him. As a general rule, he will favor a guarantee bond.

Where contractors do not have an established plant or organization in the municipality or locality where the pavement is being laid, some guarantee for the repair of such defects as may develop would seem to be a necessity. In many smaller towns a single contractor may remain for two or three years and then withdraw after the available paving area has been completely improved. It may be years before any new paving is done and it is often very difficult to get the contractor to return and make any repairs during the guarantee period.

Guarantee Obligations of Contractor

It is sometimes claimed by the contractor that, where the specifications are closely drawn and compliance with them is insisted upon, he should be relieved of the responsibility of guaranteeing results.

The committee believes that, after having examined the site of the improvement and studied the specifications, he is, or should be, fully familiar with conditions and if, after doing so he signs the contract and guarantee, he has no reasonable ground for subsequently opposing the engineer in his desire to carry out the provisions of the specifications and that such insistence on the part of the engineer does not and should not relieve the contractor of his guarantee obligations.

If he believes the specifications are faulty, he is under no compulsion to bid on the work, and if he does so, he acts with his eyes open and has no one but himself to blame. The history of court decisions would appear to show that the contractor is at least as well protected as the city when the matter comes up for legal adjudication.

We also recognize that certain large cities may have within their confines three or four large paving plants and that conditions are such that it may be difficult for an outsider to break in. In such cases it is possible to imagine an arrangement between bidders, whereby the city would pay excessively for their guarantees, but such conditions are exceptional ones and under them the same city would probably pay an excessive price for its pavements, even if it eliminated the guarantee provision from its contracts. This condition could be and has been met by the establishment of large municipal plants capable of doing a considerable portion of the necessary paving.

It has also been urged that it is not logical or legitimate to ask for guarantees on pavements because buildings are not guaranteed. The cases are not parallel. The factor of safety in a building is much greater and its life expectancy is much longer. If the average life expectancy of a building were but ten years and defects might be expected to develop within five years which might render it useless unless rebuilt, the cases might be more nearly parallel.

Having in view the facts as set forth in this report, your committee believes that notwithstanding its admitted defects, the guarantee clause serves an effective purpose and in the light of experience is economically justified.

Duration of Guarantee

We do not believe that a uniform length of guarantee for all pavements or for the same pavement under varying traffic conditions is logical or justifiable. Certain pavements are composed of blocks which in themselves have a very long life, and but little variation is to be looked for in the blocks themselves. Defects which would develop would be almost wholly defects of workmanship and two years should be the maximum period required to make this evident, and therefore, the guarantee should be limited to that time. Other pavements are composed of blocks which vary very greatly in hardness and resistance to wear and for this type we would advocate a guarantee period for the full life expectancy of the pavement without repair, as it is obviously impossible to test every block in it. Where a pavement ultimately fails through the abrasion or disintegration of the pavement itself, and is liable to prematurely disintegrate through improper materials, or mixing, or proportions, we believe that owing to the great difficulty of absolutely preventing these errors by inspection, the pavement should be guaranteed for its full life expectancy without repairs, and this can be reasonably varied to meet different traffic conditions.

We believe that the guarantee clause should be

fairly worded so as not to impose upon the contractor responsibility for conditions arising after the completion of the pavement and over which he had no control, and as covering these points would recommend for consideration the form adopted by the Association for standardizing specifications at New Orleans in January, 1912. It should also clearly set forth and be agreed to by the contractor that he accepts the guarantee as being within the reasonable life expectancy of the pavement without repairs.

In northern latitudes if the pavement is completed and accepted between November 1st and May 15th, the guarantee period should be extended so that it will expire on the first of June following in order to insure weather conditions being such as to permit of thorough examination and the making of all necessary repairs before the final taking over of the pavement by the city. This provision may be omitted when climatic conditions render it obviously unnecessary.

Supplemental Cash Retainer

Owing to the admitted defects and shortcomings of guarantees covered by surety bonds alone and the frequent difficulty experienced by cities in having even those repairs due to poor workmanship and materials made on time, we believe that the bond should be supplemented by a cash retainer, legal interest being allowed to the contractor on the amount retained.

For new construction involving grading, foundation and wearing surface we would recommend that 10 per cent of the aggregate cost of these items be retained.

For resurfacing on an old foundation we would recommend a retainer of 20 per cent.

In the case of a 2-year guarantee the whole of the retained moneys should be payable at its expiration and not before. In the case of a 5-year guarantee, one-fourth of the retained moneys should be payable two years after the completion of the pavement and the balance in three equal annual installments. The date when payments of retained moneys become due shall be governed by the clause previously recommended for pavements completed and accepted between November 1st and May 15th. If the contractor, having received 30 days notice, fails to make and complete the ordered repairs at the time any annual installment (or the whole amount) of the retained moneys become due, he shall forfeit to the city the total amount then due unless he shall have obtained in writing from the engineer an extension of the time, when the same provision shall apply at the expiration of the extension period.

Meter Company Establishing in Canada

The Neptune Meter Company of New York has acquired a building from the Russell Motor Car Company of Toronto, Canada, in which they intend to manufacture Trident Water Meters for Canadian trade. They are the largest manufacturers of water meters in the world, and the starting of a subsidiary company by them means its assured success. The president of the company is Mr. J. Herbert Ballantine, and the managing director for the Canadian branch is Mr. William H. Randall, formerly superintendent of the maintenance and distribution department of the Toronto Water Works. The new plant is to be known as the Neptune Meter Company, Limited.

The Surveyor as a Planner

Rural Development Has Been on a Wrong Basis—Surveyor Can Assist in Promoting Economic Planning

MR. Thomas Adams, town planning adviser of the Commission of Conservation, delivered an address under the auspices of the Ottawa members of the Dominion Land Surveyors' Association, at the Carnegie Library, Ottawa, on March 24th, 1919. He emphasized the importance of having a better rural organization in order to get a stable foundation for the future development of Canada.

Experience in the United States and Canada, during over a century of colonization, had shown that the chief weakness of the methods of development pursued on the American continent had been the encouragement of land speculation and scattered settlement. While everybody would agree that things would be done differently if we could start *de novo*, there was some doubt as to whether the cost and effort required to remedy the evils that had sprung up were worth while and whether it would not be better, in the long run, to let things adjust themselves. He disagreed with those who were inclined to take the latter *laissez faire* attitude to land development.

Planning is Artificial

The planning and colonization of land in new countries was, under modern conditions, an artificial thing and required the application of art and science to secure satisfactory results. The ultimate aim must be that of conserving human and natural resources and, in Canada, with its lack of population, the most important thing was that of conserving the quantity and quality of the human resources. For that purpose he pleaded that land should not merely be measured for purposes of colonization, but should be planned and developed with the object of promoting the best economic use of the land, the convenience and efficiency of our industries, and the health of the people. Scientific training and improved educational facilities, together with better means of social intercourse, must also be promoted. Thirdly, co-operation, rural credit and development of rural industries needed still more encouragement than had hitherto been given.

The surveyor dealing with the measuring and laying out of the land was responsible for the underlying conditions which promoted or retarded these objects. If the land was badly subdivided its economic use might be hampered, its transportation facilities rendered difficult, and its efficiency for production almost destroyed. If in planning the land, no regard was paid to topographical conditions so as to get directness of route and easy gradients on the main highways and so as to promote closer settlement, the effect would be that people would be too scattered and too much engaged in the fight for existence to get educational facilities, means of social intercourse and the full enjoyment of co-operation.

Making the Most of Our Efforts

Canada was limited in its resources by the extent to which it lacked sufficient population to apply the activity necessary to use and distribute its resources. Next, then, to getting more population and to conserving our natural increase of population came the question of planning and developing the land so as to pro-

duce the utmost output from the human energy we applied.

The increase of the urban population in Canada was not, in Mr. Adams' judgment, a bad thing except in the case of the very largest cities. The healthiest countries were those with numerous small cities and towns and so long as these were healthy and properly planned it was a good thing to promote a certain amount of urban concentration.

In 1911 Canada had a rural population of about 60 per cent. and about 40 per cent. urban. The tendency since had been to further increase the urban proportion. He gave figures showing that whereas the total land area of Canada was over 371,000,000 acres, of which 187,500,000 acres had been surveyed, only 20,500,000 acres were under crop. For the amount of land in farms there was far too little land being farmed. One of the conditions that had to be avoided was that of settling land that was unsuitable for settlement.

John McDougall, in "Rural Life in Canada" had given figures to show that the decrease in rural Ontario between 1901 and 1911, aggregated 373,567 and a large portion of this has undoubtedly been due to the forced settlement of land that could not be put to economic use. The results were not only economic loss, but physical and moral deterioration of the worst kind. Under such circumstances our rural districts, instead of being the recuperating places for the city population to renew its energy and strength, became less healthy than the cities themselves.

Surveyor as a Planner

Under present conditions the surveyor does not plan the land, he merely measures it. The time has come when he should prepare adequate topographical surveys and plan it for the purpose of securing its fullest economic use, even if that means greatly increasing the personnel of the profession.

A rectangular survey was excellent for the purpose of measurement and is the basis for a proper development plan, but it was not, in itself, a development plan. Radial plans would be no better. What was wanted was to super-impose upon the rectangular plan a thorough study of topography and classification of land, and to succeed these with a plan of development. Mr. Adams alluded to the failure of socialistic communities in connection with land settlement, and argued for the creation of agricultural and industrial communities without the socialistic features that had destroyed most of the communal schemes.

Just as the surveyor's plan was at the basis of the plan of the rural district, so it laid the foundation for the plan of the city. If it was begun wrong it never could be put right except at prohibitive cost. That is why the work of the surveyor was so important.

In regard to land classification, a beginning had been made in New Brunswick, but the importance of obtaining an accurate division of the land of the country into different classes for different uses had not been realized.

On the evening of Wednesday, April 16, the General Contractors' Section of the Toronto Builders' Exchange held a dinner meeting in the King Edward Hotel, when association matters were discussed. The members are very enthusiastic and hope to build a strong organization within their section. C. B. Jackson is chairman, Walter Davidson, vice-chairman, and C. F. Till, secretary.

Mainly Constructional

East and West—From Coast to Coast

The Allen Theatre Enterprise announce that they will build fifteen theatres during the next year, costing from \$125,000 to \$300,000.

Civic undertakings proposed in Calgary are extensions of waterworks costing \$200,000; the Louise bridge and the sewerage disposal plant.

A firm of Buffalo contractors proposes to erect houses in Niagara Falls, Ont., taking advantage of the provisions of the Ontario Housing Act.

Calgary's building permits for the month of March total \$195,000. This is a larger total than has been reached in any month for a considerable time.

Permits for buildings to the value of \$40,700 were issued in the city of Regina, Sask., during the month of March, making a total for the first three months of the year of \$87,400.

The painters' strike in Hamilton, Ont., has been settled, the men accepting the employers' offer of 52½ cents an hour, with an eight-hour day, except Saturdays, which will be four hours. The union had asked an increase from 45 cents to 60 cents.

The Winnipeg Building Owners' Association have expressed their approval of the Shoal Lake water which is now flowing through the new aqueduct and urge that the installation of a filtration plant is unnecessary.

The proposed work on the Temiskaming & Northern Ontario Railway includes extensions from Swastika to Kirkland Lake, a distance of seven miles, and from Timmins to Mattagami, a distance of about three miles.

The Coca-Cola Company have factories under way at Brandon, Regina, Moose Jaw, Saskatoon, Lethbridge and Vancouver. Future extensions are provided for in each of these buildings. The total expenditure involved will exceed \$1,000,000.

Wm. Dever, building inspector of York Township, Ont., reports that 132 permits have been taken out during March, including: 111 dwellings valued at \$207,300; 7 garages; 42 additions and alterations. The total value of the buildings to be erected is \$227,700.

It is stated that the Shale Brick Company of Ontario, formerly the Ontario National Brick Company, plans the reopening of its plant at Cookville, Ont., which has been closed for some time past. It is expected the plant will be in operation in a few weeks.

The Republic Motor Truck Co. have decided to establish a plant in Canada and London, Ont., has been chosen as the location. Excavation has already been commenced for the construction of a modern factory building, and an investment of \$500,000 is contemplated.

Mr. E. A. James, consulting engineer, has submitted estimates to the town council of Newmarket, Ont., for a sewerage system. The estimated cost of the work is \$100,000, which includes the installation of a line of sewers on all streets, storm sewers on main street and a sewage disposal plant.

It is stated that the Canadian National Railways propose to carry out the construction of the Canada Eastern line from Fredericton to McGivney Junction by day labor, instead of by contract. The work is to be undertaken this year. During the past year more than \$1,000,000 has been expended

by the C. N. Rys. in acquiring an up-to-date construction plant.

Hamilton's building permits for the first three months of this year reach a value considerably more than double the same period last year. The comparative figures are: 1918—January, \$51,242; February, \$65,890; March, \$93,325; total, \$210,457. 1919—January, \$174,250; February, \$189,965; March, \$231,120; total, \$595,335.

It is stated that the Toronto Housing Commission may resign unless the city is granted a special Act of the Legislature under which it may carry out its housing schemes. The opinion is held in many quarters that Toronto cannot successfully deal with her problems under the provisions of the present Act as it applies to the province. The high cost of land is pointed to as one of the difficulties.

The following Ontario municipalities have passed by-laws to come under the provisions of the Housing Act: Windsor, Sudbury, Galt, St. Catharines, Fort William, Sault Ste. Marie, Ingersoll, Sandwich, Hespeler, Port Dalhousie, Madoc, Oshawa, Port Credit. J. A. Ellis, municipal director of the Ontario legislature, estimates that the loan required by these municipalities will aggregate from \$4,000,000 to \$5,000,000. He expects that over fifteen other municipalities will come under the provisions of the Act within a few weeks and that about sixty municipalities will be operating under it by June.

GOOD ROADS ACTIVITIES

The special "Good Roads" committee of the council of Peterborough county, Ont., recently held a meeting to discuss the matter of adopting the provincial government's scheme as provided for in the Ontario Highway Act. The eight southern townships of the county were represented, and of these all except two opposed taking this step, urging that further concessions should be made by the government. At another meeting, however, at which were representatives of the council, the board of works of the Peterborough City Council, the board of trade and the Automobile Association, the opposite stand was taken and the following resolution was passed: "That this meeting of representative citizens of the county and city of Peterborough endorse the Government Good Roads System for the county of Peterborough, and that a copy of this resolution be sent to the County Council at its next meeting." It was urged at this latter meeting that the Port Hope road should be made a provincial highway.

At a recent meeting at Blairmore, Alta., delegates of municipalities from Medicine Hat, Alta., to Cranbrook, B. C., formed an association to be known as the Crow's Nest Pass National Highway Good Roads Association, electing ex-Mayor Morrison, of Coleman, president; F. C. Lawe, of Fernie, vice-president, and J. R. Smith, of Lethbridge, secretary-treasurer. The following resolution was passed: "That this convention do strongly recommend and urge upon both Dominion and Provincial governments the immediate adoption and construction of the All Canadian coast to coast highway through Medicine Hat, Lethbridge and the Crow's Nest Pass." Delegates were appointed to wait on the Alberta government requesting them to map out the route through the province of Alberta. The B. C. delegates had the full report of the B. C. government engineers showing that the Crow's Nest route was the only feasible one for such a road through that province.

The municipality of Rockwood, Man., has passed a by-law to borrow \$224,000 for the construction of 270 miles of roads and several bridges, under the provisions of the Manitoba Good Roads Act. Considerable work on the system will be done this season.

The road committee of Lincoln county, Ont., recommends that \$237,750 be set aside as an estimate for road con-

struction for the present year, also \$12,000 for maintenance, \$7,000 for construction of concrete and metal culverts and \$20,000 for grading, \$14,000 for machinery, and \$20,000 for general account. They also recommend that tar macadam roads with an approximate width of sixteen feet be adopted as the standard for the county's road system, water-bound macadam not being considered of a sufficiently permanent nature, due to the changes in traffic within the last few years.

The county council of Wentworth county, Ont., has appropriated \$50,000 for road work during the coming season.

Trade Publications

The Trussed Concrete Steel Co. of Canada, Ltd., Walkerville, Ont., have issued the eight edition of their catalog of Truscon Building Products. This is a concise little book which may easily be slipped in the vest pocket, and which will be found very convenient by the construction man. Everything the company manufactures is listed and described, usually illustrated. Much practical building information is contained with instructive tables on the use of Truscon products. A number of important buildings in which these products have recently been used are also illustrated.

Trade Incorporation

Closse Construction, Limited, head office Montreal, capital \$20,000.

The Lurie Wrecking & Salvage Co., Limited, head office Toronto, capital \$40,000.

Toronto Steel Construction Company, Limited, head office Toronto, capital \$500,000.

The Erie Sand & Gravel Company, Limited, head office Windsor, Ont., capital \$50,000.

The Megantic & Stanstead Quarry Company, Limited, head office Montreal, capital \$49,000.

The New Brunswick Contracting & Building Co., Limited, head office St. John, N. B., capital \$24,000.

John T. Marsh & Company, Limited, head office Toronto, capital \$40,000. Authorized to carry on business as builders and contractors.

A. E. Furnival, Limited, head office Toronto, capital \$40,000. Authorized to carry on business as sheet metal workers, roofers, manufacturers, general builders and contractors.

Personals

Mr. A. H. Dixon has been appointed chief engineer of the Western lines of the Canadian National Railways, succeeding the late A. T. Fraser, who was killed recently in a snowslide at Mount Robson. Mr. Dixon was formerly district engineer of the Pacific district.

Dr. J. S. Bates has resigned the position of superintendent of the Forest Products Laboratories of Canada and joined the staff of Price Bros., Ltd., Kenogami, P. Q., as chemical engineer. He has supervised several investigations into the strength of various woods for structural purposes.

Mr. W. H. Lutz, who for a long number of years has been connected with the Galt, Preston & Hespeler Ry., and the Lake Erie and Northern Ry., as secretary-treasurer, has retired from that position to take up the management of the Galt Art Metal Co. The officials of both railways made a handsome presentation to Mr. Lutz on the occasion of his departure.

Obituary

Mr. E. B. Laschinger, vice-president of the National Iron Works, died suddenly on April 16th.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Aurora, Ont.

Town Council plans construction of sewerage system costing \$100,000. Engineers, James, Loudon & Hertzberg, Excelsior Life Bldg., Toronto.

Chicoutimi, Que.

Plans will be prepared for road from here to Quebec for Department of Roads, Quebec. Engineer, M. Henry, Parliament Bldgs., Quebec.

Delta, B.C.

Municipal Council plans paving Scott Rd. and Ladner, a distance of nine miles. Clerk, N. A. McDiarmid.

Dundas, Ont.

Town Council plans construction of sewage disposal plant, cost \$30,000. Clerk, John S. Fry.

Guelph, Ont.

Plans are being prepared and tenders will be called in one month for street improvements for City Council. Clerk, T. J. Moore.

Halifax, N. S.

City Council plans construction of pavements on various streets costing \$15,000. Clerk, L. F. Monaghan.

Laval County, Que.

Specifications, etc., with sec.-treas., Henri Chapleau, Sainte Rose, Co. Laval, who is receiving tenders until 6 p.m., April 26th, for macadamizing five mile road for County Council.

Listowel, Ont.

Tenders are being received by engineer, John Roger, Mitchell, until noon, April 24th, for construction of 7107 ft. of cement pavement for County Council.

Mimico, Ont.

James, Loudon & Hertzberg, Ltd., Engineers, Excelsior Life Bldg., Toronto, have been requested to prepare plans for roads and pavements on main streets. Estimated cost \$50,000.

Nelson, B.C.

Department of Public Works, Victoria, plans construction of roadways from here to Trail, Kaslo to Ainsworth, and Cranbrook to Creston. District Engineer, Mr. Ramsay.

St. Valier, Que.

Department of Roads, Quebec, plans construction of thirty-five mile road from here to St. Camille. Engineer, M. Tessier, Parliament Bldgs., Quebec.

Wolfville, N.S.

Town Council plans paving Acadia St., cost \$25,000. Clerk, H. Y. Bishop.

CONTRACTS AWARDED

Hamilton, Ont.

\$10,000 water reservoir for Canadian Cottons Ltd., 352 McNab St. N.; General contractor, Geo. E. Mills, 614 King St. E.

New Toronto, Ont.

Intake pipe and sea wall costing \$50,-

000 for Town Council: General contractor, R. C. Huffman, 14 Wellington St. E., Toronto.

Summerland, B.C.

Work will start soon for irrigation extension costing \$8,000 for Town Council: Cement, Wm. Ritchie. Engineer, Mr. Fawkes.

Toronto, Ont.

Roadwork and bridges for York Highways Commission: Bridges, \$7,000, H. H. Blackwell, Peterboro; macadamized road, \$32,000, R. S. Fisher, 7 Bowden Ave.; macadamized road, \$30,000, A. E. Jupp, 47 Sparkhill Ave.; macadamized road, \$20,000, E. A. Dagg, 559 Sherbourne St.

Woodstock, Ont.

Sewer pipe—City Council has awarded contract to B. Blair & Co., Ltd., Riddell St.

Sidewalks, curbs and gutters for City Council: General contractor, Geo. Wilks, 26 Railway St.

Railroads, Bridges and Wharves

New Westminster, B.C.

Plans are in progress for thirteen mile railway for C. N. R., Toronto. General manager, M. H. MacLeod, Winnipeg.

Stewart, B.C.

Plans are prepared for \$34,000 extension to wharf for Department of Public Works, Ottawa. Secretary, R. C. Desrochers, Ottawa.

CONTRACTS AWARDED

St. Remi, Que.

Concrete bridge with iron fenders costing \$5,000 for Town Council: General contractors, Collette & Fils, St. Remi.

Victoria, B.C.

Plans are in progress for car slip for C. N. R., Toronto. General manager, M. H. MacLeod, Winnipeg.

Plans are in progress and tenders will be called at once for railway terminals for C. N. R., Toronto. General manager, M. H. MacLeod, Winnipeg.

North Vancouver, B.C.

C. N. R., Toronto, plans construction of wharf, cost \$50,000. General manager, M. H. MacLeod, Winnipeg, Man.

Public Buildings, Churches and Schools

Central Butte, Sask.

Plans will be prepared for \$12,000 school for Trustees School Board. Secretary, F. W. Tinkess.

Coteau, Sask.

Municipal Council plans erection of \$3,500 municipal hall. Secretary, G. E. Kinsman, Elrose.

Courtright, Ont.

Trinity Church Congregation plans erection of \$8,000 church. Dean, Canon Davis, Sarnia.

Eglinton, Ont.

School Board No. 14 plans erection of \$20,000 school. Secretary, F. J. Mulholland, R. R. No. 1, Eglinton.

Fort William, Ont.

Plans and specifications are with architect, R. E. Mason, Victoria Block, who is receiving tenders until noon, April 30th, for erection of \$80,000 addition to collegiate for Board of Education.

Plans and specifications are with architect, R. E. Mason, Victoria Block, who is receiving tenders until May 9th, for erection of additions to schools costing \$80,000, for Board of Education.

Guelph, Ont.

Bulk, or separate tenders received by architect, S. B. Coon & Co., Excelsior Life Bldg., Toronto, until May 1st, for erection of \$50,000 school.

Halifax, N.S.

Tenders will be called May 1st for erection of three schools costing \$310,000 for School Board, 81 Sackville St.

Holy Heart Seminary, 51 Quinpool Rd., plans addition to building.

Tenders will be called May 15th for erection of "St. Patrick's" school costing \$150,000, for School Board, 81 Sackville St.

Hespeler, Ont.

Town Council has secured site for erection of \$7,000 public library. Clerk, M. E. Jardine.

Kelowna, B.C.

Hospital Board plans erection of \$3,000 nurses' home. Committee, P. B. Willets, J. Ball and Rev. E. D. Braden.

London, Ont.

Plans are in progress and tenders will likely be called soon for erection of post office and customs house costing \$500,000, for Department of Public Works, Ottawa.

Merritt, B.C.

Tenders are being received until noon, May 12th, for erection of nurses' home, cost \$5,000, for Trustees Nicola Valley General Hospital. Secretary, A. R. Carrington. Architect, F. R. Corp.

Montreal, Que.

Stevens and Lee, 2 College St., Toronto, have been appointed architects for \$500,000 building for Notre Dame Hospital, 351 Notre Dame E.

Olinda, Ont.

Plans will be prepared for \$3,500 parsonage for Universalist Congregation. Prices wanted on all materials. Pastor, Rev. L. P. Jones, Olinda via Ruthven.

Ottawa, Ont.

Tenders are in and contract will be awarded shortly for French Baptist Church. Architects, Richards & Als, 126 Sparks St.

Portage la Prairie, Man.

General Hospital Board plans la

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and Engineering Review

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Public Institutions Will Do Well to be Patriotic

CANADIAN industries must be encouraged and Canadian products given a fair chance if the solution of the reconstruction problem in the Dominion is ever to be attained. Canadians at home and overseas have suffered manifold losses in four and a half years of war and it has been their one ray of hope that such a reconstruction would be secured after the war as would establish on a solid basis Canada's social, economic and industrial structure. We have been hearing these four and a half years, that the Dominion can never be the same, that it must be more independent, less subordinate, in short, more of a world nation.

It is with regret, therefore, that one notices at this critical time a flagrant instance of partiality towards a foreign competitor for trade, a case of throwing by the board Canadian companies capable of filling the demand, indeed, waiting for four and a half years to fill his very demand. But the case is more than flagrant when it is recognized that the offender is one of Can-

ada's great universities—an institution that, through thousands of its sons, has done its country service, and directed its every effort towards the Great Cause. Yet no sooner has the direct need for such direction of effort passed than it proceeds to forget the policy of practising what it preaches.

The whole case is simple; it may be stated in a few words. After five years of waiting, this institution has planned expansion and development. Plans for new buildings and new equipment have been prepared. Canadian contractors and manufacturers, also, for five years have been waiting to supply any need for such new buildings and new equipment. Yet without even consulting the possible sources of supply in Canada, this institution gives the contract for part of its equipment to a foreign concern. Canadian firms were prepared to manufacture and supply this material, but were not even asked to make a tender price, not even consulted as to what they could do.

This seems, perhaps, a simple instance. It is true we speak at the moment of only a single contract, possibly not an expensive contract, but there is a principle involved. We have been fighting for a principle and after the war we must not forget that there are still principles to fight for. It requires foresight to attack our reconstruction problems—foresight to see that our industries do not stagnate. The governments, from civic to Dominion, are responsible for ensuring in a certain measure that Canada derives a benefit from the war. But the public institutions—and the private concerns and individuals, no less—have in their grasp one key to national recuperation and development by exercising their prejudices, other things being equal, in favor of Canadian products, and Canadian enterprises. Let them not be hypocrites to themselves, else they are guilty of a huge mock patriotism.

Councils Fool Themselves by Not Acting on Tenders Called

A REAL difficulty confronting the contracting business is that the general public do not realize that it costs money to figure the cost of jobs and submit tenders. An all too usual practice is for a town council, for example, to call tenders on a piece of roadway, or sidewalk, or other municipal work long before they have any definite idea of going ahead with this work and merely to satisfy the curiosity of the members of council as to what such work might cost if they had the money to pay for it. A very little thought on the part of these members would surely convince them that, sooner or later, they pay for this expense. The contractor is not a philanthropist, nor could he afford to be, however, much he may be inclined. Every hour's work performed by himself or his staff in compiling the necessary data upon which to submit a tender represents just so much in dollars and cents—which the consumer must pay, for the simple reason that there is no one else to pay it.

It is fallacy to think that contractors can submit a tender "off the bat" so to speak. A tender of this sort is worth exactly what it costs to produce it—nothing. Ninety-nine times out of a hundred it will be wrong, either too high or too low. If too high the taxpayer pays too much; if too low, he gets a poor job—for the contractor cannot afford to deliver service for which he gets no payment.

A recent case came to our notice in the eastern part of Ontario, where tenders were called on three consec-

utive occasions on certain stretches of roadway. Naturally, and necessarily, the tenders were larger each time. Finally, a friend of one of the councillors, not a roadway contractor at all, profiting by the valuable information gathered by the several contractors and submitted in good faith to the council, endeavored to cut in and was only prevented from getting the contract by the most strenuous efforts on the part of one or two of the members who appreciated the meaning of square dealing.

At best, however, the sum total of the matter is that the council now pays a higher price for the work than they needed to pay, and the contractors' organizations have been standing idle in the meantime "eating their heads off."

Organization of Canadian Overseas Engineers

THE Canadian Military and Civil Engineers' Association is the name of a new organization composed of Canadian engineers with the First Canadian Division overseas. The main objects of this organization are to protect the interests of the members, to render financial assistance and to take care of dependents. Major F. J. O'Leary, M.C., who has just returned, in outlining these objects, referred to the difficulty of a professional man resuming his practice, having lost touch with conditions, prices and market values of materials. The Association will assist in the work of helping men to get back to their work, and Major O'Leary suggests that the Government might also come to their assistance. The following officers were elected in France: General Sir A. C. MacDonell, K.C.B., C.M.G., D.S.O., commanding 1st Canadian division; Col. A. MacPhail, C.M.G., D.S.O., O.C., 1st Brigade, Canadian Engineers; Lieut.-Col. J. M. Ralston, D.S.O., consulting engineer, of Vancouver; and Lieut.-Col. E. Pepler, D.S.O., of Toronto. Col. MacPhail, Major G. R. Turner and Major F. J. O'Leary form a military committee to answer queries.

Uncalled-for Interference

MR. D. K. TROTTER, secretary of the Association of Montreal Building & Construction Industries, has written a letter of protest against the "carters who are interfering with the carters employed by city contracting and building supply firms, who are thoroughly satisfied with the wages they receive, in some cases being paid more than the union demands, and who have been held up, ordered to go to the union headquarters, send in their applications for membership, pay the needful dues, and receive a "button". One member, whose horse and rig were held up in this fashion, was told that the load of sand that was being conveyed for a very special building job was the last that would get through till his driver (who also acts as his chauffeur) got his "button." Other drivers, employees of our members and not of any cartage company, have had their loads dumped in the street and damaged, been turned back and threatened. Will our members have to organize, as they are seriously considering, for the protection of their workers? Will all the citizens have to form a big union for the protection of our property? Or shall we ask the Mayor of Seattle to help us out? With the aspirations and aims of organized labor the members of this association are heartily in sympathy, but they most strongly object to the methods adopted to attain the end we all have in view."

What Will be the Status of Female Labor?

A REPORT of the "British Departmental Committee on the Engineering Trades After the War" contains the following reference to the future status of female labor in the engineering industries. This report was prepared before the signing of the armistice after a survey of the field of usefulness of women in factory work.

During the war the increase in the in number of females employed has been extraordinary, and the result has been on the whole very satisfactory. There is no doubt that on light work involving repetition, female labor is quite as good as male labor. Although some employers have, for various reasons, expressed their unwillingness to continue to employ female labor after the war—reasons which do not seem always good ones—there is no doubt that most employers will be anxious to continue to employ female labor on the lighter repetition work. It is to be supposed that after the war a great many women and girls now employed will voluntarily cease work. Many of them are at work for patriotic motives; many others because their male supporters are abroad. The return of the discharged soldier will necessitate the re-establishment of the home, and a large number of women may be expected gladly to lay down the work which they have undertaken only out of a sense of duty.

It must not be forgotten that the large extensions which have taken place during the war to so many engineering works will afford the means of employing many more workpeople than before; and if for this reason only, there will remain a considerable opening for the employment of female labor.

It seems to us that the continuance of a certain amount of female labor is both necessary and desirable. So many boys have been undertaking men's work that, as one witness put it—"Boys will be men, and girls will be boys." But we do not look upon female labor in the engineering trade as likely to be permanent or that many will be permanently employed. The feeling of the workingmen has always been the honorable one of desiring to support his wife without requiring her to earn; and marriage has always been, and we trust will always be, a reason for the discontinuance of factory work by women. We think, however, that those women who are already employed, should, in all fairness, be offered the right to continue in the work they have undertaken; and we consider that, within the limits of their strength, they are fully capable of doing good work and that for a time, at any rate, their services will be needed.

As marriage will in most cases take them out of engineering work it is of very little use for them to spend time acquiring all-round knowledge at the expense of the increased output attained by confining them to one or a few operations only.

This appears also to be in accordance with their natural inclinations. Few show any wish to leave work they are doing well to gain wider experience. One advantage to the boy apprentice would accrue from giving women a large share of small repetition work; it would free him for the general work that affords the proper training for the skilled man. If women are employed permanently, suitable arrangements for their health and comfort should be made, and we attach great importance to an older woman being in charge of the girls to supervise them.

Huge Industrial Development by Brunner Mond Co. at Amherstburg, Ont.

Soda Ash Manufactured in Canada by Plant Which Controls All Stages from Raw Material to Finished Product—Sewage and Water Systems for Town

THE new soda ash plant of Brunner, Mond Canada, Limited, is a plant which has been constructed at Amherstburg, Ont., on the Detroit River, as a new key industry, the manufacture for the first time in Canada of the essential commodity, soda ash, an article which in importance of use ranks second only to pig iron. Heretofore Canada's entire supply of soda ash, upon the use of which many of her greatest manufactures are dependent, has all been imported into the Dominion, but the operation

wood framing, is used for temporary walls, which are destined to be removed as the plant grows. Most of the roofs are of the usual reinforced concrete tile construction, but those on the boiler house and shop building are of gypsum slabs 14 inches wide and five or six feet long, known commercially as "Pyrobar." All roofs are covered with a three-ply tar felt roofing. Since roofing gravel is scarce and expensive, $\frac{1}{2}$ inch screened limestone from the quarry was used for a top dressing on the roofs with good results. The basements of the buildings are connected by reinforced concrete subways, which serve as pipe tunnels as well as an easy means of communication.

The steam power plant consists of four 600 h.p. boilers equipped with superheaters. The boilers are fired by automatic stokers, working under forced draft and equipped with permanently attached soot blowers. The boiler settings have three gas passes, after which the gases are discharged into a brick flue located on the operating floor, so arranged that feed water economizers may easily be installed when desired.

Coal Mechanically Handled

The coal supply for the boiler house and all other parts of the plant is received in bottom-dump gondola cars and is dropped into a hopper under the coal track. A pan feeder delivers this coal to a single roll crusher, after which it is transferred to the bunkers in the top of the boiler house by means of an inclined belt conveyor and a distributing belt conveyor with travelling tripper over the bunkers. Coal is automatically supplied from the bunkers to each boiler stoker by means



The Brunner Mond Company's plant manufactures soda ash for first time in Canada

of this plant will furnish Canada with an independent source of supply, producing within the boundaries of the Dominion, from natural resources hitherto undeveloped, all the soda ash which the country will need. The economic and industrial advantage to Canada resulting from the development of this new industry, the utilization of natural resources and the employment of several hundred men in the process, is so great as to make the construction and operation of this plant take prominence as one of the most noteworthy of recent Canadian achievements.

The process to be employed at this plant in the manufacture of soda ash utilizes as two of the principal raw materials, limestone and salt, the former of which is quarried on the company's extensive properties at the plant, while the latter comes from the vast beds of rock salt underlying this part of the country. The plant has been constructed in accordance with the most modern and up-to-date theories and practice and probably is the most complete one of its kind. Fig. 1, taken from the west, gives a general idea of the size and construction of the plant and its surroundings.

Plant Design and Layout

In general, the buildings rest upon ample reinforced concrete foundations. Their frame work is of structural steel and all permanent walls are built of reinforced concrete. Corrugated asbestos, or iron on



A general view of the plant from another angle

of two 12-inch steel pipe spouts with a cast iron lateral or Y near the middle of each. The branch and one end of the run of each lateral is connected to the two parts of the spouts, while the other end of the run points downward and is sealed with a blind flange. In case the upper parts of these spouts become clogged

they may be cleaned out by removing these flanges and allowing the loose coal to fall to the floor. The obstruction may then be broken up with a bar.

The ashes fall from the stokers into large concrete-lined steel hoppers suspended from the ceiling of the boiler house basement. While still hot the ashes are dropped into steel-hoppered Gallion electric trucks and dumped into a deep concrete quenching pit just outside of the boiler house basement. When this pit becomes full it is emptied by a locomotive crane into railroad cars and taken to the dump. In order to secure the concrete lining which is only 4 inches thick, to the smooth vertical steel plate surface of the ash hoppers, $\frac{1}{4}$ in. x 2 in. machine bolts were tapped into these plates from the inside about a foot apart. Poultry netting was then attached to the heads of the bolts and an inside wooden form was built. The concrete lining was then poured with pails.

Power House Equipment

The engine room contains two 600 kw. and one 300 kw., three phase, 60 cycle, 480 volt General Electric turbo-generators with two 25 kw. steam turbine-driven exciters. The necessary d.c. current for elevators, hoists, etc., is supplied at 230 volts by two 50 kw. General Electric motor generator sets. The switchboard equipment was furnished by the General Electric Company and the Northern Electric Company, and is installed in a switchboard gallery 12 ft. x 72 ft. and about 8 ft. above the engine room floor. The cable room is located directly beneath in the basement. The space on the engine room floor under the switchboard gallery floor is used as a storage and battery charging room for the Gallion trucks when not in use. Cooling air for the generators is drawn from out of doors through a Carrier air washer and conditioner and is handled through air ducts under the basement floor and cored in the generator foundations.

Next to the generators are five specially designed steam driven plunger pumps for handling salt brine and ammonia liquor, and back of these are three engines direct connected to special cylinders for compressing carbonic acid gas. Next to these engines are two others of the same size, one of which is a vacuum pump, while the other is a spare unit for either the vacuum pump or the compressors. Two Chambers inclined steam-driven vacuum pumps, with gas cylinders 16-in. x 16-in., and a 500 cubic foot Ingersoll Rand two-stage air compressor complete the engine room equipment.

All other machinery in the plant is motor driven. For heavy duty drives the first speed reduction is usually either a belt or a Link Belt silent chain. If the drive is compact, gearing is usually used for the second and third speed reductions, while if the shaft centres are some distance apart, roller chain is used. Light duty drives consist of belts.

The high pressure steam piping consists of standard weight lap-welded steel pipe. The piping from 10 in. to 4 in. inclusive is equipped with rolled steel bolting flanges made on the pipe with a Lovekin pipe flanging machine. All steam piping under 4-in. is equipped with screw flanges. All valves and fittings are of cast steel made by Crane Company. The exhaust steam main is 36 in. in diameter and is fabricated in convenient lengths of riveted steel plates with cast steel bolting flanges.

Soda Dryers

There are four soda dryers installed, equipped with automatic stokers working under forced draft. Ventila-

tion of the firing room is obtained by means of a fan which draws fresh air from out of doors and discharges it through the basement floor from an air duct underneath. Coal for these stokers is drawn from the coal bunkers in the boiler house into Gallion trucks in the basement. These trucks are elevated to the main floor, near the dryers, on an Otis elevator, and the coal is dumped into hoppers in this floor directly over the stoker fronts. This gives a gravity feed for the coal and eliminates all manual labor. Under these stokers is an ash tunnel with ash hoppers similar to those for the boilers. After a truck has brought coal to the stokers it is lowered into the ash tunnel on the elevator and loaded with ashes. It then makes its return trip to the boiler house basement, dumps its load of ashes into the quenching pit, and is ready for another load for the dryers.

Limestone, which is received from the quarry, described further on, is charged into the lime kiln by means of a skip hoist. The burnt lime is delivered by a belt conveyor to the boot of an inclined bucket elevator. This elevator delivers the lime to elevated storage bins in the slacking plant. This plant consists of a cylindrical tank which is so arranged that it automatically separates the milk of lime from the sands and



Pump house and purification plant for Amherstburg's water supply

spawls. While the lime is stored for use, the sand is dropped into railroad cars and, taken to the dump, while the spawls are returned to the kiln for reburning.

The shop system includes a machine shop, boiler shop, blacksmith shop and tin and plumbing shop housed in a fireproof building 36 ft. x 256 ft. Besides the usual small machine tools are a 42-in. x 16-ft. engine lathe, a four foot radial drill, a 12-in. x 4-in. pipe cutting and threading machine, a 1,500 lb. steam hammer, a combined punch and shear and cast iron bending and straightening blocks. The carpenter shop wagon and horseshoeing shop and garage are scattered in other buildings.

The sewer system consists of a five-foot reinforced concrete sewer about 1,800 feet long. A four-foot re-

inforced lateral sewer connects with the other and runs deep under the basements of the buildings. The usual small lateral sewers of all sizes discharge into these two large ones.

The five-foot and four-foot sewers are about thirty feet below the general ground level. Under the top soil is a yellow clay, nearly as hard as hard pan, which at the plant site extends downward about fifty feet to rock. On this account it was first thought that the sewers could best be built of brick by tunneling. It was found, however, that this clay weathered quickly on exposure to the air and developed vertical cleavage planes of a reddish brown oxide or sulphide, after



Rock is handled in 1000-ton crushing plant

which it caved on the least provocation. The open trench method was then adopted with concrete sewer tile substituted for brick. Though heavily timbered and sheeted, considerable caving of the banks occurred. The excavation, setting of tile, and backfill were accomplished by means of three travelling stiff-leg derricks.

After the four-foot sewer had been in place for some time one portion under heavy foundations started to fall by cracking on the horizontal and vertical diameters. The trench was opened up and as much dirt as could easily be removed was taken from under the concrete tile. The trench was then filled up, around and over the tile, with concrete. The concrete over the top of the sewer was reinforced with old wire fencing, and to date no further trouble has developed.

Four Sand Filters Purify Water Supply

To secure a pure water supply for the plant and the town of Amherstburg, a water pumping and purification plant was built. The pump house is located on the Detroit River at the harbor line. It contains two low lift pumps, three service pumps and three fire pumps for handling the filtered water; and three pumps for delivering raw water from the river to the plant for operation. These pumps are all of the motor-driven DeLaval multi-stage centrifugal type, ranging in capacity from 300 to 2,000 gallons per minute, and operating under heads of from 50 ft. to 250 ft. All pumps handling raw water take their suction from the basement of the pump house, into which the river water flows, through two five-foot Link Belt travelling intake screens.

The filtration plant is located about 300 feet inshore from the pumping plant, on a small bluff about 30 feet above mean water level. It contains two coagulating and settling basins and four sand filters, built above a 100,000 gallon purified water reservoir. A 30,000 gallon reinforced concrete tank occupying the top floor of the building furnishes water for washing the filters. The special equipment consists of three Gauntt dry coagulating chemical machines; a Simplex rate-of-flow controller; Bristol indicating and recording gauges and filter underdrains furnished by the Norwood Engineering Company. A Wallace and Tiernan chlorinating machine is located in the pump house and discharges into the suction of the two low lift pumps, which supply raw water to the filtration plant.

Both the pump house and purification plant are built of reinforced concrete, with tapestry brick panel walls, and present a very pleasing appearance. The pump plant is equipped with an Ideal steam boiler and wall type radiators, while the purification plant is heated by a hot air furnace.

A 12 in. class "C" pipe line, about 8,000 ft. long, delivers the purified water to the distribution mains in Amherstburg. It contains a 12 in. Venturi meter tube near the pump house, and another at the northern limits of the town. Both tubes are equipped with indicating and recording gauges.

Production of Raw Materials

At the quarry, back of the plant, the rock bed is covered by only a few feet of earth, and this is removed by a portable steam shovel, into side dump contractors' cars of standard gauge, and taken to the dump or where needed at the plant for fill.

The bed of soda stone is 26 ft. in thickness, and lies under a 34 ft. bed of dolomite. In order to uncover the soda stone, a 1,000-ton crushing plant has been installed to prepare the dolomite rock for concrete, ballast and road-making purposes. The rock drilling is done by Loomis electric-driven well drills, with 5 in. bits, while jackhammers are used for re-shooting the larger pieces of rock.

The crusher building and storage bins are of timber construction and are equipped with a No. 11 and No 7½ McCully crusher, and the usual complement of rotary screens, elevators, etc. All of the machinery is motor driven, power being furnished from the plant at 4,400 volts, and transformed to 480 volts at the crusher plant.

At the Canard river, three miles north of the plant, are four wells which furnish the strong salt brine necessary for making soda. These wells are about 1,200 feet deep and reach to an enormous bed of rock salt. Pumps force this brine through an eight-inch pipe line about three and one-half miles long to the plant.

Power is supplied from the plant at 4,400 volts, and is stepped down to 480 volts at the pump house.

All buildings of the plant are liberally equipped with sanitary equipment, locker rooms and other conveniences for the employees. A Mutual Benefit Society, to which all employees belong, has also been chartered by the Ontario Department of Insurance, and pays sick and death benefits to its members. A six-bed hospital is maintained at the plant, and all accident cases are cared for here. The provincial government provides compensation for all accidents.

Transportation to all parts of the plant and quarry

is obtained by means of several miles of standard gauge railroad track equipped with 70 lb. and 85 lb. rails. Switching connections at the quarry allow easy access to the M. C. R. R. and the Essex Terminal R. R. The building of docks in the Detroit River for shipment by water is now under consideration.

The officials of the company are E. N. Trump, president, of Syracuse, New York; Sir Edmund Walker, vice-president, of Toronto, Ontario; Andrew H. Green, Jr., vice-president and managing director, of Detroit, Michigan, and Wallace Campbell, secretary and cashier, of Syracuse, New York. G. S. Rutherford is resident manager.

Uniform Wages for Workmen

Association of Montreal Building and Construction Industries Attempting to Secure Fixed Wages and Eliminate Sub-Contract Abuses

THE Association of Montreal Building and Construction Industries has lately shown great activity in certain directions, notably in the matter of industrial housing, the cost of building and advisory labor councils. It has now tackled the thorny subject of uniform scales of payment to workmen. This question and that of sub-contracts, was discussed at a recent joint meeting of the general and sub-contractors' sections.

Mr. W. M. Irving, president of the Association, who presided, explained that the question of the wages to be paid in the various building trades during the summer of 1919 had been lately before the general contractors' section, and at the April meeting of the latter referred to the board of directors. The directors considered that the question of wages was a subject that interested the sub and trade contractors equally as much as the general building contractors and decided that the best way to give a lead to the various members of the trade, the architects and the building public was to have a joint meeting of the two sections, when the wages of all the building trades might be considered and recommendations made that would be of interest and value to all interested parties.

Working With the Unions

During the discussion the question of the relation of the association to various labor unions was raised, and the practically unanimous resolution was that no agreements should be entered into with these unless it was established beyond doubt that each union controlled its own members, was local in its inception, management and organization, was incorporated and was in a position to stand back of every agreement entered into with employers.

Some members, however, were opposed to negotiating with any union, considering that no union in the Montreal building trades represented more than a small fraction of the workers in any particular trade. One case was cited in which of fifty workers in one trade employed by a contracting firm only ten were members of their union; and this was a union that during the last few months through its representative had been making considerable stir and giving the public the impression that it controlled all the workers in its particular trade in the city.

The subject of the relation of the increase in build-

ing costs to the cost of living was also discussed, the chairman quoting figures showing that building costs had only increased one-quarter as much as the cost of living had increased. The opinion was unanimous that no material decrease in building costs could be looked for in the immediate future; and as slight decreases in the prices of some building materials would be offset by small increases in the prices of certain classes of labor, the general result would be that present building costs would remain practically stationary for the next three years. Some members prophesied that never again would it be possible for prices to come down to a pre-war level.

Attention was drawn to the inequality in the number of hours daily worked by the employees in the building trades, and it was unanimously resolved that the members be recommended to adopt for all classes of their mechanics and laborers a nine-hour day, from 7 a.m. to 5 p.m. with an hour off at noon for lunch.

Recommended Wages

The wages to be paid carpenters during the coming building season were considered. It was asserted that it was impossible to have for them a uniform scale in the city. Some carpenters are working for from 35 cents an hour and upward, and it was just as easy to secure these men at 35 cents an hour as at a higher wage. The majority of the carpenters employed on the jobs were just handy men, and it was unfortunate that skilled carpenters, real mechanics, were generally getting the lowest wages. One member suggested that the law of supply and demand be allowed to settle the wages to be paid. Again it was stated that many firms and individuals who contemplated building are holding off till the prices demanded for labor become more reasonable, and lots of work was being held up for this reason. The chairman remarked that the state of the building trade was worse than it had ever been, even during the war, and that they as an organization, with the help of the workers, should do everything in their power to stimulate the building industry, and provide all the employment they could at reasonable rates of remuneration for the large number of their skilled mechanics who were out of work to-day. This was not to be done by paying wages which were on an uneconomic level, but by arranging building operations and costs so that as large a number of men as possible could be employed.

In some trades it was possible that slightly lower wages would have to be paid than had obtained in the past. This, he was sure, all the members regretted; but he believed the worker would appreciate that smaller wages with a reasonable hope of continuous employment in these times was much better than artificially inflated wages earned in an intermittent fashion.

It was resolved that members of the association be recommended to pay carpenters from 45c to 50c per hour for a nine-hour day.

Two Bricklayers' Organizations

The wages to be paid bricklayers caused considerable discussion, as it was pointed out that there were two bricklayers' unions operating, each claiming to control a majority of the tradesmen in the city, and that the demands of these were different.

Mr. John Quinlan, in moving that a committee be appointed to meet a committee of the Bricklayers' Union of Montreal, and discuss wages and working

conditions, stated that this union was local and incorporated and in a position, he believed, to carry out its contracts and agreements. The motion was adopted unanimously.

In regard to common labor it was resolved that whereas the general rate of wages for building laborers is \$3 per day for a ten-hour day, members be recommended to pay henceforth \$3 per day for a nine-hour day.

Regarding painters' wages, it was resolved that the members be recommended to pay competent painters from 40 cents to 45 cents per hour for a nine-hour day.

One member stated that on and east of St. Lawrence boulevard all the painters necessary at the present time could be obtained at 35c per hour.

Further, the members were recommended to pay their plumbers and steamfitters 50c per hour, and their helpers 30c per hour, and electrical workers from 40c to 50c per hour.

Consideration of the wages to be paid other trades was deferred till a later meeting.

Eliminating Sub-Contract Peddling

The Board of Directors also remitted to the meeting the question of sub-contracting, it being suggested that in all original tenders the sub-contractors be named. It was proposed by one member that the subject be referred to the architects' association for their opinion. A general contractor recommended a system whereby the secretary of the Association of Montreal Building and Construction Industries would be notified by the general contractor of the sub-bids he desired, and that the sealed sub-bids would be forwarded to his office and placed in a locked receptacle there, to be opened only when the time for tendering had expired and in the presence of the competing sub-contractors. A trade contractor blamed the general contractors for the irregularities that had arisen in connection with the letting of sub-contracts as in many cases, he stated, they had gone outside the list of sub-contractors furnished by the architect, and hunted up some friend of their own. He recommended that the selection be left to the architect.

It was resolved that the suggestion that sub-contractors be mentioned in original tenders be remitted to the sub-contractors' section with the invitation that its members suggest a remedy as to how the peddling of sub-contracts can be eliminated.

Promise of New Building Code for Montreal

At last there is likely to be effective action regarding the Montreal building by-laws, many of which are out of date, and which, as a whole, are complicated. For years the city has been in possession of a new code, drawn up by a voluntary committee representing the architects, engineers and contractors, but action has been postponed time after time on various pretexts. The administrative Commissioners have invited the Association of Montreal Building and Construction Industries to co-operate with other bodies interested and with representatives of city to compile a new code. Accordingly the board of directors of the association have appointed Messrs. J. P. Anglin (or John Quinlan), K. D. Church, and E. B. Evans, to represent the association.

The Board of Direction of the American Concrete Institute has decided to hold the convention of the Institute at Hotel Traymore, Atlantic City, on June 27 and 28.

March Building Permits

ACTIVITY in the building trades, as indicated by the value of building permits issued in 35 cities showed an increase during March as compared with the preceding month, the total value of building permits rising from \$1,863,462 in February to \$3,014,365 in March, an increase of \$1,150,903, or 61.8 per cent. All the provinces except New Brunswick, Manitoba, and Saskatchewan reported gains in comparison with the preceding month. As compared with the corresponding month in 1918, there was an increase of 40.9 per cent., the value for March, 1918, being \$2,138,391. New Brunswick, Manitoba and Saskatchewan also recorded declines in this comparison.

Of the larger cities, Toronto and Vancouver reported increases both as compared with the preceding month and with March, 1918. Montreal and Winnipeg showed gains as compared with February, while at Edmonton there were declines in both comparisons. Of the smaller centres Halifax, Quebec, Brantford, Hamilton, Ottawa, Windsor, Moose Jaw, Calgary and Victoria all showed large increases both as compared with February, 1919, and with March, 1918.

Estimated Cost of Building Work as Indicated by Building Permits Issued in Thirty-five Cities

City	March, 1919	March, 1918	March, 1919, compared with March, 1918	
			Increase (+) Amount	Decrease (-) Per cent.
Nova Scotia	282,230	\$ 93,426	*\$188,804	* 202.09
Halifax	256,775	47,768	* 209,007	* 437.55
Sydney	25,455	45,658	† 20,203	† 44.25
New Brunswick	42,625	45,600	† 2,975	† 6.52
Moncton	19,375	1,500	* 17,875	* 1,191.67
St. John	23,250	44,100	† 20,850	† 47.28
Quebec	379,250	272,129	* 107,121	* 39.36
Montreal	228,208	241,600	† 13,452	† 5.57
Maisonneuve	96,467	22,329	* 74,138	* 332.03
Quebec	96,467	22,329	* 74,138	* 332.03
Sherbrooke	25,700	25,700	* 25,700	* 100.00
Three Rivers	14,250	8,140	* 6,110	* 75.06
Westmount	14,025	14,025	* 14,025	* 100.00
Ontario	1,777,947	1,004,349	* 773,598	* 77.02
Brantford	20,955	8,925	* 12,030	* 134.79
Fort William	1,275	97,450	† 96,175	† 98.69
Guelph	4,720	11,820	† 7,100	† 60.07
Hamilton	231,120	93,325	* 137,795	* 147.65
Kingston	8,535	5,660	* 2,875	* 50.80
Kitchener	21,880	14,970	* 6,910	* 46.16
London	58,520	29,615	* 28,905	* 97.60
Ottawa	234,540	98,970	* 135,570	* 136.98
Peterborough	2,990	3,250	† 260	† 8.00
Port Arthur	5,457	3,015	* 2,442	* 81.00
Stratford	4,690	1,670	* 3,020	* 180.84
St. Catharines	28,820	31,755	† 2,935	† 24.99
St. Thomas	9,960	1,975	* 7,985	* 404.30
Toronto	1,005,560	529,664	* 475,896	* 89.85
Windsor	143,925	72,285	* 71,640	* 99.11
Manitoba	63,900	188,902	† 75,002	† 58.99
Brandon	21,200	3,252	* 17,948	* 551.91
Winnipeg	42,700	135,650	† 92,950	† 68.52
Saskatchewan	119,400	459,100	† 338,700	† 78.99
Moose Jaw	27,300	7,300	* 20,000	* 273.97
Regina	40,700	442,150	† 401,450	† 90.79
Saskatoon	51,400	9,650	* 41,750	* 432.64
Alberta	197,600	27,410	* 170,190	* 620.80
Calgary	195,400	23,000	* 172,400	* 749.57
Edmonton	2,200	4,410	† 2,210	† 50.11
British Columbia	151,413	97,475	* 53,938	* 55.34
New Westminster	9,700	4,300	* 5,400	* 125.58
Vancouver	119,013	79,190	* 39,823	* 50.29
Victoria	22,700	13,985	* 8,715	* 62.32
Total—35 cities	\$3,014,365	\$2,138,391	*\$875,974	* 40.96

The city of Outremont, P.Q., is inviting competition for a small housing scheme. Plans and specifications for semi-detached cottages, cost not to exceed \$6,000 each, exclusive of land, are to be deposited by May 7. Pries of \$150 each are to be awarded for each pair of cottages, making a total of six prizes. The city will secure full rights to the successful plans.

The Building Contract of the Future

Speculative Elements in Lump-Sum Contracts—Cost-plus-fee Contract Secures Co-operation of Owner, Contractor and Architect

By Sullivan W. Jones

THE contract system which was in almost universal use before the war had revolved about two wholly false assumptions: One, that a modern building can be described by drawings and specifications with sufficient completeness to provide for an accurate computation of costs, and, hence, for bids on its construction that are fairly competitive; and the other, that the contractors' business is that of selling finished work, and that he is essentially a merchant, who should, but by no means always does, possess a specialized knowledge of the suitable and economical use of the things he buys and sells.

The first of these false assumptions leads us direct to a consideration of the sufficiency of the architect's service, while the latter involves a study of the contractor's status under this form of contract. We have thus established at least one direct relationship between the two fundamental questions. While they have been stated separately, so interwoven are they that discussion of them singly is impossible.

Speculative Elements in Lump-sum Contracts.

Let us assume for the moment that we wish to hold to the lump-sum form of contract and competitive bidding. Obviously, then, we must find some way of giving to the contractor in advance the information essential as a basis for fair competition on price? Can it be done? Drawings and specifications may be improved through further standardization; inaccuracies of quantities may be largely removed by the adoption of the quantity system; and the cost of work may be placed upon a more accurate basis by the "open-price," which will also raise the price standard and assure a better margin of profit to the contractors. But are these partial remedies all that is necessary?

There are always several ways of doing a thing, one less costly than another, and there will always be differences of opinion between the contractor and architect as to which is the best, or whether the substitute proposed is permissible under the contract. There will always be disputes over questions of quality because quality, both in workmanship and materials, is well-nigh impossible to describe.

There is another important speculative element in every lump-sum contract, and it will exist even if drawings and specifications could be perfected. It is this element of risk which has now acquired such proportions that no sensible man is willing to assume it. When a contractor signs such a contract, he sells short for delivery over a stipulated period of time, the quantities of labor and material required. In some localities, in times more normal than these, or than those to which we look forward, the risk of loss to the contractor from a rising labor market has been minimized by wage agreements with organized labor. In other places that stability has not been secured. And the material market never has been and never can be brought under control. Estimating, even under the most favorable conditions, will always involve risk to the contractor, and as long as there are risks, competition will be based on risks instead of work to be

done. The low bid, whether it be too low or not, will always be the product of the greatest error or the assumption of the greatest risk.

Which is Wrong, Competition or the Stipulated Price?

Let us examine the case for the lump-sum contract. I have said it had a corrupting influence on everybody involved in it. Almost every ill and every evil in the building industry, I am satisfied, may be traced to the lump-sum contract. Under it the interests of the owner and contractor are diametrically opposed. The contractor's profit lies between the actual cost of the work and the amount of the contract. The greater the cost, the less the profit, and vice versa. The contractor's aim is, therefore, to deliver as little as possible, while the interest of the owner is in exacting the utmost of the contractor. The contract stands between them, setting up antagonisms where there should be co-operation, creating conflict of purpose where unity of interest is essential to success. Under the lump-sum contract the contractor has been a merchant, buying and selling finished buildings.

The arguments against the general contractor being a merchant are possibly more conclusive than any that can be directed against the merchandising function for the sub-contractor, especially the sub-contractor who manufactures and installs a product, but they apply, nevertheless, with the force of conviction to both. The general contractor manufactures none of the materials which he handles. He has no plant or factory and has no legitimate use for either. He has no capital invested in anything of permanent value to him. The money which he uses in conducting his business is a temporary substitute for the owner's capital ultimately represented by the finished building. What is it the contractor has to sell? Service, his expert knowledge of the fabrication of buildings. In the last analysis, service is the thing he has always sold, but instead of selling it to his employer, he has sold it to himself. The system has placed a premium on disloyalty and shrewdness in the contractor, rather than on engineering skill and efficiency.

The same contradictions have confused and misled the sub-contractor. He has wasted his best energy fighting for trade discounts on the materials he purchases in order to resell them competitively at a possible profit. He, too, has struggled to make a livelihood through the purchase and sale of labor and materials when he should have centered his effort on perfecting his service and finding a market for it. If service is the commodity in which the contractor deals, and we wish to preserve competition, obviously, then, competition must be in service and not in the price for finished work. The value of service is measured in terms of results. If economy is one of the results looked for, and secured, let it be an asset to the contractor instead of stolen fruit to be concealed.

Lump-sum Contract Unfair to the Architect.

But we have not yet put in all the evidence against the lump-sum contract. The architect has not escaped its insidiously evil influence. The average owner, the

owner who is inexperienced in matters of construction, undertakes his venture on the assumption that the architect is omniscient, and that when a bid is received on the drawings and specifications it is all-inclusive. This is the fallacy of the complete and sufficient drawings and specifications. A mistake is made when an architect accepts employment without disclosing to his client the unavoidable limitations which are placed upon his service. As the work proceeds, omissions are discovered, differences arise as to what is meant by vague expressions and indications, and the architect is at once placed on the defensive with respect to the sufficiency of his drawings and specifications. He has the choice of confessing his plight to the client or covering it up by compromise with the contractor. Some pursue the former and honorable course; others the latter. The position of the architect under such a contract is unwholesome. It is unfair to him. It is unfair to the owner who has sought the architect's advice on the basis of confidence. It is unfair to the contractor. It is a high tribute to the profession, and the professional tradition, that so few architects have succumbed to the temptations which constantly urge them to abandon the difficult role of conscientious servant.

That the architect is keenly alive to his untenable position, and to the gravity of the consequences to the whole building industry if conditions remain unchanged, is evidenced through the appointment by the American Institute of Architects of a Post-War Committee on Architectural Practice, charged with the study of the architect, his function, relation to the public and public interest, and his education; and by the principles adopted as fundamental by the Committee on Contracts and Specifications in connection with its deliberations on the cost-plus-fee form of contract. These two committees, beginning work on two distinct questions, have found that their labors are complementary; and I venture to predict that in the end their work will be co-ordinated, at least to this extent: That the Committee on Contracts and Specifications will perfect the cost-plus-fee form of contract and the other committee will recommend its universal adoption.

Cost-plus-fee Contracts

The cost-plus-fee contract, as we have known it, has been a compromise document. The status of the contractor, by reason of his contract liabilities, and by reason of the unchanged attitude of the architect and owner, was not radically different under this form of contract from what it had been under the lump-sum contract. While his interests coincide with those of the owner, the contractor failed to realize the nature of the relationship, and, consequently, his attitude of mind remained unaltered. The Committee on Contracts and Specifications feels that the change must be complete, and that such changes must be made in the document as will give the contractor a new picture of his status and responsibilities. The committee asserts that, "in the light of recent experiences of the Government in the use of the cost-plus-fee system the following general principles are felt to be fundamental":

"(1) The contractor becomes in effect a professional adviser of the owner as his 'construction manager' and should be relieved of all contract liabilities inconsistent with such a relationship; (2) For this purpose the owner should pay directly for all materials and should enter directly into contract with sub-contract-

ors rather than having subcontractors make their contracts with the contractor. Payrolls must perforce be paid by the contractor and reimbursement made by the owner; (3) In view of this professional relationship no 'bond' guaranteeing performance is needed or proper, any more than for the architect."

It is difficult to comprehend at once the full significance of this statement. The principles enunciated find expression throughout the document. There was a discussion on the expediency of changing the term "contractor" to "constructor," or "manager of construction," or "constructing engineer," but it was decided that a wiser course to pursue was to use the old and familiar term and let the contractors' wishes gradually crystallize into the choice of some substitute term which would be more appropriate and more descriptive of the new function.

This is the wording of the clause, which, in the older form of contract, was captioned "subcontracts." It now bears the title "separate contracts":

"All portions of the work that the contractors' organization has not been accustomed to perform, or that the owner may direct, shall be executed under separate contract. In such cases, either the contractor shall ask for bids from the contractors approved by the architect and shall deliver such bids to him, or the architect shall procure such bids himself, and in either case the architect shall determine with the advice of the contractor and subject to the approval of the owner, the award and amount of the accepted bid. The owner shall contract direct with such approved bidders, etc., etc."

This clause, it will be observed, establishes the relationship between the so-called sub-contractor and the owner or architect, which the sub-contractor has sought to realize through the elimination of the general contractor.

Advantages of Cost-plus-fee Contracts

It must now be plain that the architect's status and function cannot be considered without considering, also, the status and function of the contractor. It seems almost superfluous to point out the advantages to the whole building industry from making the cost-plus-fee contract the rule instead of the exception. It is important, however, for us to think of this proposed change in terms of results, so that we may all have a clear conception of what it is we are striving for. But when we think in terms of results, we again find it impossible to think of the architect and the contractor separately. First, the contractor, or let us call him the constructor, will be selected on the basis of confidence and his service record. Since the contractor's profit will no longer depend upon his ability to cheapen the work, which has been the motive underlying the general practice of offering substitutions, we may expect fewer discussions of this kind in the future. Considerations of price alone will less and less influence the selection of materials. The architect and the contractor will work together instead of in opposition. The knowledge and experience in construction which the architect lacks, will be furnished by the "constructor."

This, to my mind, is one of the most important results that will be secured, for it must be realized, and is realized by the thinking element in the architectural profession, that ability in design, which reaches its highest development only in men who are sensitive, imaginative, and impulsive, is wholly incompatible with the scientific quality of mind that works

in exact terms of fact and statistics; an essential prerequisite to the proper performance of the "constructor's" function. Under the cost-plus-fee form of contract, the architect, the contractor, and the owner enter into a tri-party agreement to accomplish a single end. It does not require much imagination to see in this change in the contractor's status the reincarnation of the master builder of the Renaissance, through a virtual, if not an actual partnership of the two talents that produced the world's most inspiring and enduring architectural monuments.

The salvation of the architect, the contractor, and the industry lie in such a partnership of talents. If it cannot be brought about, I predict that contractors will try to become architects as well, and that architects will attempt to become builders—and, in the broad sense, few will succeed. Buildings will be either poorly constructed or poorly designed, and the loss to the public and in the prestige of the industry will be immeasurable.

In connection with the adoption of the cost-plus-fee contract system, I wish also to point out the importance of a standard cost accounting system and the greater value of the open-price plan as a powerful factor in education and in establishing mutual confidence.

Building Loans Differently Arranged

There is one, and only one, serious difficulty which lies in the way of securing these fundamental reforms. It will be necessary to effect a change in the policy of the lender of money for construction. Relatively little new construction is carried forward without building loans. Such loans are usually a certain percentage of the contract cost of the building. The question is, can the great lending companies be made to feel that they will be amply protected in lending the same percentage on a carefully prepared estimate by a reputable "constructor," even though the amount of that estimate is not guaranteed by a contract and bond? I believe that, ultimately, such loans will be secured on the basis of confidence, even more readily and with less question as to values and risks than has been the case in the past. And I believe also that loans so made will be more secure than those made on the lump-sum contract ever have been. This must be so, because the building will be a better investment; both upkeep and depreciation will be less, and costs will rest on the stable foundation of true values, not on the insecure basis of speculation.

The above article is from a paper read before the Institute of Electrical Engineers.

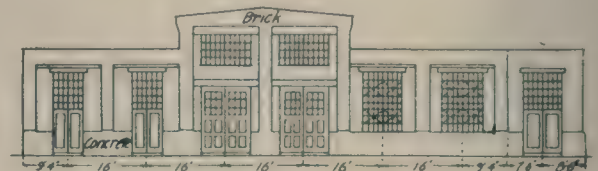
To assist its employees in building homesites and thereby relieve the acute housing situation in Vancouver at the present time, the B. C. Electric Railway Co. has set aside a fund of \$50,000, which will be loaned at 6 per cent. interest for a term of 12 years. This fund will be placed in the hands of a joint committee, composed of members of the Office Employees' Association and the management of the company. The money is already available.

Page Wire Fence Co. Plan Factory at Three Rivers, Que.

THE E. Laurie Company, consulting engineers, Montreal, have drawn plans for a new factory for the Page Wire Fence Company of Canada Limited, the head office of which is located at Walkerville, Ontario. This is the first unit of the plant, and is to be situated on Notre Dame St., Three Rivers, immediately east of the Three Rivers shipyards. The site is to be graded to an elevation above flood water level, approximately 12,000 cubic yards of fill being required for this purpose. The building runs parallel to Notre Dame St., with the building line set back sixteen feet from the street line.

The plans provide for a one-storey structure, 290 feet long by 99 ft. wide, divided longitudinally into 18 bays and transversely into 13 bays, the centre bay having clear storey lights. The foundation and walls up to the sill level are to be of concrete, and the external wall of plastic brick. All internal columns and the roof girders will be of steel. Fenestra steel sash windows are to be used, liberal provision having been made for ventilation.

The roof will be constructed of three inch plank, supported on heavy B. C. purlins. The roofing will



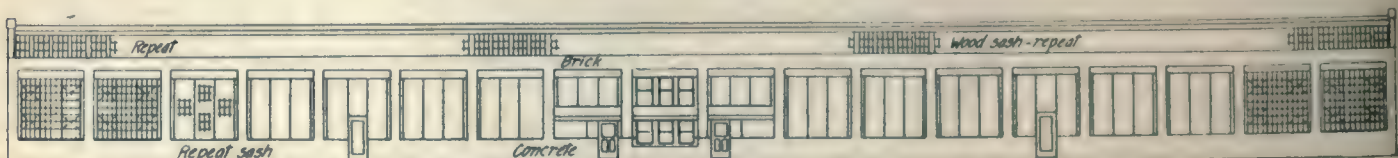
End view of proposed factory

be built-up asbestos roofing, with all roofs internally drained. With the exception of the office bay, the whole area of the factory will have a concrete floor. The tube and iron stores at the east end will be enclosed by steel grille partitions, these being the only departmental spaces to be partitioned.

The offices are to be located at the centre bay on the south side, while the timekeeper's office and tool store will be on the ground floor, with the general office and superintendent's office above. The office partitions will be glazed, and will give an uninterrupted view of the whole shop area.

The paint shop consists of a 31 ft. x 30 ft. one-storey annex on the north side of the factory, being connected with the latter by an automatic fire door. The steel windows in this shop are glazed with wired glass. The roof will be of fireproof construction on the Seigwart beam system. The dipping tanks will be sunk below the floor level.

The scale house, 18 ft. by 13 ft., will be an annex to the main shop. The products of the shop will be automatically weighed and conveyed to the store building, or to the cars for direct shipment. All ma-



Elevation of Page Wire Fence Company's new factory

terials and finished products will be handled by overhead industrial tracks.

The shop will be heated and ventilated by hot air, the boiler and fan house consisting of a detached building fronting on the midway. The shop will be electrically lighted. Automatic sprinklers will be installed in the shop, while outside water mains will be laid with fire hydrants located at points to command the whole of the plant. Lavatory accommodation will be provided near the end of the shop, and all fittings will be of the latest sanitary factory type.

Railroad connection with the C. P. R. main line will be secured through a new spur line. This line will be extended through a 70 ft. wide midway to Notre Dame Street, and three sidings installed.

Ottawa Contractors and Supply Dealers

FOLLOWING up the policy of forming branches in all the principal cities, the Ottawa branch of the Association of Canadian Building and Construction Industries was established at a meeting of the Capital's contractors and supply dealers in the Chateau Laurier on April 16th. Close to one hundred attended the meeting. In the past years several associations have been formed by the Ottawa contractors, but interest in the local organizations gradually died out; the new branch, however, promises to put the organization of contractors on a more stable basis. It was unanimously decided at the meeting to get the branch on the active list by starting off with generous subscriptions to carry on the work.

Increase in Building Cost

Mr. J. P. Anglin, President of the Association of Canadian Building and Construction Industries, attended the meeting and outlined the aims and work of the Association. Speaking on the increased cost of living and industries, Mr. Anglin declared that since 1913 building costs, including supplies and labor, have only increased 57 per cent., which is, relatively speaking, the lowest increase of any of the industries. Statistics showed that farm produce had increased 123 per cent., clothing 152 per cent., drugs 104 per cent., and house furnishings 133 per cent. In outlining the importance of an organization for contractors, Mr. Anglin stated that the building fraternity would eventually "put themselves and their industries in Canada on the map." In the past years contractors had never been consulted by the government on matters dealing with reconstruction and other important problems, and he stated that strong organization was the only means by which the fraternity would be able to command recognition. Mr. Anglin outlined the propaganda scheme and voiced his approval of a standard form of contract, which would provide for labor troubles. "If Canada is to go ahead in the next few years we have all got to work together for a maximum amount of production in all lines," the speaker stated. "As it is now, we are only getting about 25 per cent. efficiency, where it should at the least be 50 per cent. We pay the men the wages they demand, but to increase our efficiency there must be some other incentive. Get your men to understand

and take an interest in your business, and it will aid as a solution in solving the reconstruction problem."

Preliminary steps were taken by the contractors at the meeting to cope with any trouble that may arise with the building unions this coming May, which has been anticipated by many local contractors. Representatives from the contractors and supply dealers were appointed on an executive committee which will interview the Minister of Labor on the labor question and appoint a council to meet representatives of organized labor to arrange a compromise should any trouble arise.

The following were appointed on the executive committee: Messrs. Hugs J. Graham (secretary); Sid. Smith; V. Hall; W. G. Adamson, carpenters; A. Garvock; T. C. James; Alex. Robertson, bricklayers; J. B. Duford, painters; J. R. Murphy, plasterers; J. T. Blyth, plumbers and steamfitters; J. O'Toole; J. Foley, and T. C. Bate, general contractors; W. A. Mattice, structural steel; E. M. Barrett, lumbermen; Ruggles Wright, quarrymen; Richard Hooper, stone cutters; J. R. Douglas, galvanized iron and roofing; J. A. Ellacott and P. Ackroyd, electricians; A. K. Mills, marble and tile; Thos. McLaughlin, roads and sewers; and W. Cuzner, hardware.

Mr. A. S. Clarson, general secretary of the Canadian Association, gave an insight into the reconstruction problem and the aims of the organization. "The contracting fraternity," stated Mr. Clarson, "is just like a great big democracy which was poorly organized in Canada. Now, without efficient public and private education the corporation of contractors would easily wander into Bolshevism of industry. A primary duty of reconstruction, as we are viewing it, is not only a better understanding between all builders and contractors, but more efficient education. To this end we should have a representative sitting on every government commission that may be appointed, which has to do with repatriation, reconstruction, immigration, or any other progressive movement that may arise along the lines of conservation of energy and ability. Public opening of tenders is another aim. We are determined that our Canadian goods will be used wherever possible. With all respect to our American friends, we should not buy building material from the United States when our own manufacturers can supply as good, if not better, material." Mr. Clarson stated that labor matters would be fairly dealt with by the association, and that the association expected to have the co-operation of Mr. Tom Moore, president of the Trades and Labor Congress.

Mr. J. T. Blyth spoke on the labor problem and stated that it was going to be impossible for any contractor to exploit labor or make money out of labor. "Labor is so strong," asserted Mr. Blyth, "that at the present time the only way to deal with the proposition is on a business basis. It is up to the building trades to organize on a basis where we can meet organized labor and arrange terms where the workingmen shall have something more than a bare living wage."

Mr. Charles Hopewell presided at the meeting and said that with earnest co-operation there was no doubt that the organization in the Capital city would be a pronounced success.

A hearty vote of thanks was extended to Mr. J. P. Anglin, and Mr. A. S. Clarson, for coming up from Montreal, and for their assistance and co-operation in forming the new local organization.

Sewage Disposal by Dilution, Chlorination of Effluent and Treatment of Sludge

By W. C. Easdale

EARLY in 1915 the author was called upon to design the sewers and sewage disposal works for a large military camp in the north of England.

At that time all military works were looked upon as being of a more or less temporary character, and although it was not possible to construct temporary sewers and sewage works, it was desirable to keep the cost as low as possible.

A Military Camp Disposal Works

The site of the camp possesses several interesting features from the sewage point of view. It extends over three separate valleys, each drained by a brook, the three brooks ultimately discharging into a river of considerable size at some distance from the camp. At first it appeared that three separate outfalls would be necessary, and as the effluent would be discharged into small brooks, the disposal works would have to provide a high degree of purification. A careful investigation of the site, however, showed that it was possible to convey the whole of the sewage by gravitation, by the use of aqueducts or syphons, to one

20 ft.; in another a cast-iron inverted syphon is used to cross a valley.

Rain Increases Volume of Sewage

The sewers were originally laid on the strictly separate system, all rain water being carried direct to the nearest watercourse. Since the work was completed, however, it has been found necessary to connect the rain-water from some roofs and paved surfaces to the sewers, as a consequence of which the volume of sewage in times of rain is increased to a considerable extent. The sewers are designed to be capable of taking three times the maximum hourly flow of sewage, and although a storm-water overflow is constructed on the outfall sewer near the disposal works in case of emergency, up to the present it has not come into operation. In dry weather there is very little fluctuation in the flow of sewage from hour to hour. The greater part of the sewage runs off between the hours of 7.30 a.m. and 10.30 p.m., and is practically at a uniform rate. From 10.30 p.m. to 7.30 a.m. there is a very small flow, and this also is at a uniform rate.

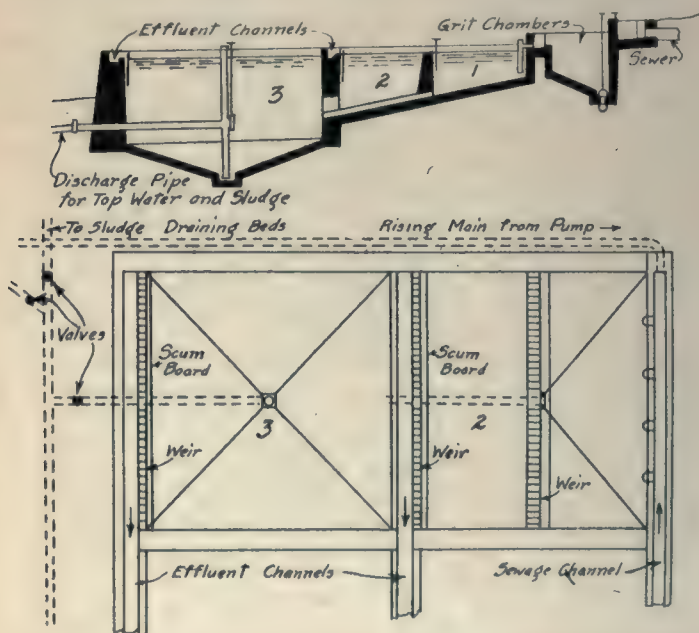
A very favourable site was secured for the disposal works in a field about half a mile distant, and out of sight from the nearest part of the camp. The only inhabited buildings in the neighborhood are two farms, each about a quarter of a mile from the works. The outfall sewer reaches the tank half way down a considerable fall in the ground at a level about 20 ft. above the lower and flatter portion of the site which is available and of ample area for filters should these become necessary in the future. In addition, there is sufficient area for considerable extensions of the tanks and other works if required.

Method of Disposal

With the object of arriving at a decision as to the best method of disposal to adopt, the primary consideration was the reduction of expenditure, and the second was the most suitable point of discharge of the sewage effluent. The nearest watercourse is one of the brooks already mentioned, which would necessitate the production of a highly-purified effluent. By carrying the effluent about 400 yards further, it can be discharged into a comparatively large river. The flow of this river in dry weather was found by rough gauging to be about forty times the estimated volume of sewage, and analyses of the water showed that while it contained evidence of previous pollution by sewage, as indicated by the presence of 100 bacillus coli per c.c., it was at the same time completely saturated with dissolved oxygen.

As the current velocity was very rapid—viz., 103 ft. per minute—and it was possible to arrange the outfall in such a manner as to secure thorough mixing of the sewage effluent with the river water in a short time, it was evident that the conditions fulfilled the requirements laid down by the Royal Commission on Sewage Disposal in their eighth report, paragraphs 4 to 42, as suitable for disposal of the effluent by dilution.

The chief arguments in favour of such a scheme were that the initial outlay for works would be very



Caterick camp sewage works—longitudinal section through settling tanks and plan of one unit of tanks

point, and thus avoid the high cost of construction and management involved in the adoption of three separate outfalls and sewage works.

Except at a few points where it was necessary to cross roads, the whole of the main sewers, about 9 miles in length, are laid in fields. As there is a total fall of 300 ft. from the highest to the lowest portion of the camp, a distance of about 3 miles, the gradients of the sewers are exceptionally good, but owing to the configuration of the ground the sewers in some places are laid on the surface, while in others they are carried over brooks at considerable heights. In one case an 18-in. sewer is carried on piers at a height of about

much less than would otherwise be necessary, and that it seemed right and proper that, under the exceptional conditions of the war, advantage should be taken of the recommendation made by the Royal Commission in its eighth report (paragraph 3) to the effect that "the law should be altered so that local authorities should not be required to purify their sewage more highly than is necessary to obviate the risk of actual nuisance arising from its discharge." The author, therefore, prepared and submitted a scheme on these lines, and it was duly approved and carried out.

The volume of sewage to be treated was given by the authorities as 15 gallons per head per day. The author allowed a margin of safety of 33 per cent and based his calculations upon 20 gallons per head per day; but even this has proved to be too low a figure, as the volume in actual operation has been about 30 gallons, and, although the works have not yet had to deal with the total population provided for in the calculation, the daily volume has, on a number of occasions, exceeded the total volume for which the works were designed.

In preparing a scheme for disposal by dilution, it was considered necessary to have in view:—

- (a) The removal of the maximum percentage of solids in suspension;
- (b) The maintenance of the sewage in a fresh condition while passing through the tanks; and
- (c) The treatment of the sludge in such a manner as to facilitate its disposal without causing any fouling of the tank effluent.

The attainment of these three objects involved the design of a special type of tank, which has been proved in actual operation to fulfil these requirements. Owing to the excellent gradients, the sewage arrives at the works in a fresh condition, without putrefaction having been set up while in the sewers.

Description of Works

Two grit chambers were provided, without screens at first. In a short time it was found that a large amount of rags, socks, shirts, caps and other foreign materials in the sewage caused so much trouble—especially in connection with the sludging operations—that it became necessary to construct a screen chamber fitted with duplicate hand-operated screens. Deposits in the screen chamber and in the grit chambers are discharged by sludge valves and pipes to a separate draining bed and are afterwards spread on the land.

The settlement tanks are four in number, each divided into three compartments. The first compartment receives the sewage after it leaves the grit chambers through four submerged inlet pipes provided with hand penstocks for regulating and shutting off the flow. The outlet is in the form of a long weir the full width of the tank, and with a baffle board in front of it. It will be noticed from the drawing that, taking the length as being in the direction of the flow this compartment is twice as wide as it is long. In effect the sewage flow, contrary to the usual practice, takes place across the shortest dimension of the tank. This arrangement was adopted in order to obtain the greatest possible length of weir outlet and thus facilitate the deposition of the solids in suspension. As a result of two and a half years' operation, it can be stated that the bulk of the solids are actually deposited in this compartment. The deposit found in the next compartment through which the sewage flows has always been very small in quantity and consists only of very finely divided suspended matter.

The floor of the first compartment is constructed with a rapid fall from three sides to the centre of the long dividing wall, the top of which forms the weir outlet. At this point an outlet fitted with a penstock is connected to a c.i. pipe laid on the sloping floor of the second compartment. By this means the whole contents of the first compartment, including both sludge and scum, can be discharged into the third compartment as described later. It is found in practice that a very even distribution of the flow of the sewage through this first compartment is obtained. This is doubtless due chiefly to the use of four inlets about 5 ft. apart and to the long weir outlet, but also to the fact that the lower ends of the inlets terminating close to the sloping floor cause the sewage to impinge upon the floor and spread out over a considerable area of the tank.

Arrests Finely Divided Suspended Matter

The second compartment receives the already well-settled sewage from the first compartment and serves to arrest the finely-divided suspended matter still left in the liquid. The floor has an even slope in one direction from the inlet end to the bottom of the wall between the second and third compartments where large openings are left to afford free passage for the sewage between these two compartments. This arrangement was provided in case of an emergency necessitating the passage of the sewage through all three compartments, and has been utilized on occasions when the flow has been greater than originally anticipated. The usual outlet for the final effluent is from the second compartment by way of a long weir with a baffle board in front of it along the full width of the tank. In this case, as in the first compartment, the length of the weir is twice the distance through which the sewage flows.

The tank effluent flowing over this weir falls into a channel communicating with all four tanks and fitted with a sluice gate at its junction with the main channel. The sludge in the second compartment is discharged into the third compartment through the openings in the dividing wall.

It will be seen that the whole of the solids deposited in the first two compartments can be discharged by gravity and with very little labor into the third compartment, while the effluent after settlement is discharged after passing through the first two compartments alone. As the combined capacity of the first two compartments is equal to about three hours' flow of the sewage, and the deposited solids in the first are removed every week, the sewage remains fresh and does not become fouled in its passage through the tanks.

Secures Complete Digestion

The third compartment is designed to retain the sludge for the period necessary to secure complete digestion without risk of the products of digestion affecting the character of the effluent. The bottom is in the form of an inverted cone, the greatest depth at the centre being 15 ft. to the top water level. The sludge is not allowed to accumulate to a greater depth than 6 ft. and at this level an outlet is provided in the form of a horizontal cast-iron pipe connected to a vertical standpipe extending from the bottom of the cone to above the top water level and serving as a sludge discharging pipe. At the junction of the horizontal cast-iron pipe with the vertical standpipe a valve is provided through which the supernatant liquid is drawn off to a pump by which it is delivered into the inlet channel to mix with the fresh sewage and be treated again.

In case it should be found desirable to run the sewage through all three compartments, the third compartment is provided with an outlet weir and effluent channel similar to that provided for the second compartment.

The horizontal cast-iron sludge outlet pipes from the four sets of tanks are connected to a common discharge pipe leading to the sludge draining beds with a branch leading to a pump, for dealing with the supernatant liquid as previously described.

The capacities of the separate compartments of the tanks are as follows:—

First compartment 1-20th, first and second compartments combined 1-8th, and third compartment 1-5th of the estimated daily dry-weather flow; the total capacity of the whole of the tanks is 1-3rd of the daily dry-weather flow. The size of the third compartment was determined chiefly by the sludge storage capacity.

Method of Operation

With the normal flow the sewage enters the first compartment near the bottom, flows across the tank, up under the baffle board, and out over the long weir. It enters the second compartment at the top, flows down and across the tank, up under the baffle board, and out over the long weir into the effluent channel. Normally there is no flow of sewage through the third compartment.

The suspended solids deposited in the first and second compartments are discharged once per week into the third compartment in the following manner:—The valves on the inlets to the first compartment are closed and the supernatant water in the second and third compartments is drawn off through the cast-iron stand-pipe to the pump and delivered to the other tanks in operation at the time.

When this has been done, some sewage is admitted to the first compartment (which has remained full) and as this overflows into the second compartment it washes down the sludge on the floor into the third compartment. The valve on the outlet at the bottom of the first compartment is then opened and the whole contents, including sludge and scum, is also discharged into the third compartment. The discharge of the thick sludge at the bottom is usually assisted by a man using a squeegee; but this is not really necessary, as such assistance can be rendered simply by admitting small quantities of sewage, which break up and carry through practically the whole of the sludge on the floor, and even thick blocks of scum. It will be noticed that by this means the troubles which occur in many places in removing the sludge and scum by hand labor are avoided, and the whole of the solids are brought together for further treatment separately as sludge in the third compartment.

Once a month the well-digested sludge in the third compartment is drawn off by opening the valve on the horizontal outlet pipe. The valve on the vertical stand-pipe being closed, the head of water in the tank forces the sludge around the bottom of the pipe up and out along the common sludge pipe to the sludge-draining beds.

Objectionable Features Eliminated

There are several interesting features in connection with these tanks. Although scum forms in the first compartment, there is none in the second and third compartments. The effect of the digestion of the sludge in the third compartment might be expected to produce a very foul liquid and to cause nuisance from

smells. As a matter of fact, this does not happen. There is no objectionable smell either from the tanks themselves or from the supernatant liquid when it is drawn off and pumped up for further treatment. While the tanks stand full, very few bubbles of gas appear at the surface. As the head is reduced when the supernatant liquid is drawn off, gas bubbles appear in ever-increasing numbers, and when the liquid has been lowered 7 to 8 ft. the surface is boiling with escaping gas bubbles. From this it may be safely inferred that the pressure due to the head of water (from 8 to 10 ft. above the top of the sludge) causes the gas to be retained in the sludge and liberated only when the sludge is discharged on to the draining beds. This probably also accounts to some extent for the comparatively rapid rate at which the sludge is dried on these beds, the escape of the gas at this stage rendering the sludge more open and thus allowing the moisture to drain away easily.

It should be observed here that the gas from the sludge when it does escape, has not at any time given off the characteristic odor of sulphuretted hydrogen associated with septic tanks, and one of the most remarkable features of these works is the entire absence of any objectionable smell even when the sludge is being discharged. This has been recorded in other cases of somewhat similar methods of treatment, notably in the United States, and it has been suggested that the gas in question consists almost entirely of methane or marsh-gas. Slight local smells that have

ANALYSES OF CRUDE SEWAGE AFTER PASSING THROUGH GRIT CHAMBERS AND TANK EFFLUENT AFTER CHLORINATION.

Sample taken.	Suspended Solids.			Chlorine.		Oxygen consumed in 5 minutes.			Chlorine added.
	Crude Sewage.	Tank Effluent.	Per cent Removal.	Crude Sewage.	Tank Effluent.	Crude Sewage.	Tank Effluent.	Per cent Purification.	
	Parts per 100 000.		%	Parts per 100,000.			%	Parts per million.	
1917									
Oct. 23 ..	39.0	22.5	42%	11.6	—	4.3	4.0	7%	4.4
Oct. 25 ...	38.3	11.9	69%	11.6	—	3.7	2.5	32%	4.3
Oct. 27 .	60.5	17.6	70%	11.6	—	3.4	2.4	30%	4.9
Average daily volume of sewage, 660,500 gallons.									
1918									
June 17 ...	42.1	7.9	81%	8.9	10.1	4.6	2.4	48%	9.63
June 19 ..	43.2	8.3	80%	9.6	10.2	4.8	2.8	41%	9.52
June 21 ...	42.7	9.8	77%	9.3	10.7	4.8	3.4	30%	9.20
Average daily volume of sewage, 778,666 gallons.									

been noticed on a few occasions have been from the screenings or fresh sludge from the grit chambers, or from dried sludge which has accumulated once or twice in heaps and has commenced to putrefy.

These tanks can be worked in three different ways. In the first the sewage is passed through the first and second compartments, flowing out by way of the effluent channel between the second and third compartments. In the second, the sewage passes through all three compartments and out by way of the effluent channel at the outer end of the third compartment. In the third method, part of the sewage flows out from the second compartment and part from the third compartment—i.e., both effluent channels are in operation

simultaneously. So far as the quality of the effluent is concerned in respect to solids in suspension, there is very little difference in the results obtained by either of the three methods of operation. With regard to the question as to whether the digestion of the sludge is affected by the passing of the fresh sewage through the third compartment and whether it is more thorough when the fresh sewage passes through the first and second compartments alone, sufficient information is not yet available. Further observations over a considerable period are necessary before this point can be settled. In the author's opinion, the chief factor in the matter is the pressure due to the depth of the supernatant liquid whereby the gases formed in the sludge are retained therein and only escape when the pressure is removed by the discharge of sludge on the sludge-draining beds.

The efficiency of these tanks in the removal of the solids in suspension is indicated in the foregoing analytical figures.

Measuring Apparatus

The tank effluent as it leaves the two effluent channels mentioned above enters the main effluent channel in which is fixed a gauging weir with a Lea Recorder, which records the flow of sewage on 24-hour charts. This apparatus has been extremely useful not only in measuring the daily volumes, but in registering the hourly fluctuations in the rate of flow.

Chlorination of Tank Effluent

In order to be in a position to anticipate any possible complaints as to the bacterial pollution of the river water, the author included in his scheme means for adding sufficient chlorine solution to destroy all bacillus coli in the tank effluent. The whole of the apparatus used in this part of the scheme was supplied by the Candy Filter Company, Limited, and consists of a special mixer for converting the chloride of lime (bleaching powder) into a liquid solution, an air cylinder and pump for raising the solution into two concrete settling tanks built at a higher level, a water wheel operated by the treated sewage for working the pump and mixer, and a special automatic control for regulating the quantity of the chlorine solution, discharged into the settled sewage. The automatic control is in the form of a miniature weir which is connected to a float controlled by the weir used in connection with the Lea Recorder, so that the depth of chlorine solution flowing over the miniature weir is always in exact proportion to the sewage flowing over the large weir. In this way correct automatic regulation of the quantity of chlorine added to the sewage is ensured according to the variation of the flow of sewage.

Thorough mixing of the solution with the effluent is secured by means of a series of slate baffle plates fixed in the effluent channel, and the effluent then passes through two tanks, which have a total capacity equal to half an hour's flow of the sewage, in order to give the period of contact required for the chlorine solution to act upon the bacteria.

After the works had been in operation for some time it was found that, in spite of the settlement of the crude chloride of lime solution in the two tanks provided for the purpose and used alternatively, a considerable amount of lime was deposited in the pipes leading to the regulating apparatus. To overcome this trouble, further settlement has since been provided in the form of an additional settling tank, which now receives the crude solution; the clear liquid from this

tank flows by gravity into the original settling tanks, where further settlement takes place and a much clearer solution is thus produced.

In a scheme of water supply recently carried out by the author, the above-mentioned trouble in connection with the use of chloride of lime has been avoided by the use of an electrolytic chlorine solution. The raw material in this case is common salt, which is dissolved in water to a given strength. This brine then flows at a fixed rate through an electrolyser fitted with a series of electrodes to which the electric current is connected. The passage of the electric current through the brine decomposes it, liberating chlorine and sodium, as well as hydrogen and oxygen. The oxygen and chlorine then combine and form hypochlorite of sodium, which possesses exceptionally powerful germicidal qualities. The solution contains from 0.2 to 0.3 per cent of free available chlorine. It is perfectly clear, does not cause a deposit in the pipes, and is of definite strength.

Thoroughly Digested Sludge Drawn Off

By means of the arrangements provided in the settling tanks, it is possible to draw off only thoroughly digested sludge. This is discharged by gravitation to four sludge draining beds. These beds are simple excavations in the ground and are provided with ample under-drainage in the form of rows of 2-in. agricultural pipes connected to a 4-in. main sub-drain, which conveys the drainings to a sump under the pump-house. The pump used to deal with the supernatant water from the settling tanks, has a branch on its section pipe taken into the sump, and by this means the drainings from the sludge are pumped up to the sewage inlet channel for further treatment with the fresh sewage.

The draining beds are formed of a bottom layer of coarse gravel, upon which rests a layer of fine gravel, which supports a top layer of coarse sand, the whole being only 18 in. deep. The sludge is delivered on the beds from a concrete channel constructed along the centre of the beds with openings controlled by hand sluices on both sides. As the sludge is delivered in a fairly liquid state, it distributes itself evenly over the surface. In normal weather the sludge is dried to a spadeable condition in about eight days. A representative sample of the sludge taken from one of the beds at this stage was examined for the author by Dr. S. Rideal, and it was found to contain 72 per cent moisture and 0.9 per cent nitrogen, which is equal to 2.8 per cent on dry sludge containing 10 per cent moisture.

For some time at first the dried sludge accumulated in a heap at the works. Later, arrangements were made with the farmer whose fields adjoin the works to use the sludge for his land. By the spring of 1918 the original accumulation of sludge had all been removed, and since that time the whole of the dried sludge has been taken away by the farmer as produced, so that the only sludge on the works is that which is being dried on the draining beds.

The good effect of the sludge was apparent in the early summer from the excellent appearance of the crops to which it had been applied. According to a report from the farmer, the continued wet weather during the latter part of the summer spoiled the crops of wheat, barley and oats, and considerably reduced the yield. In spite of this, the result was about twice as good as in previous years on the same farm, and much better than on neighboring farms where the sludge

was not used. The best results were obtained when the sludge was ploughed in during the autumn, and it is recommended that the sludge should be accumulated in convenient heaps during the other three seasons, and not spread on the land until the autumn. It was anticipated that the use of the sludge would produce a large crop of weeds, but very little of such vegetation has appeared. There is no evidence to show whether this was due to the absence of seeds in the sewage or to some effect upon them of the action which takes place during the digestion of the sludge in the tanks.

Effluent Outfall

The tank effluent after it leaves the tanks, provided to ensure sufficient contact of the chlorine solution with the sewage, flows down a series of aerating slopes into the effluent pipe, which conveys it for a distance of about 500 yards direct to the river. At the outfall the top of the river bank is about 8 ft. above the summer water level. At this point the effluent drain terminates in a manhole, from which a cast-iron pipe is laid about 3 ft. deep in the bank from which it emerges at about summer water level and then continues on the sloping bed of the river for a distance of about 15 ft. terminating with two outlets in the deepest part of the stream at the bottom of the river. There is al-

the dilution was only 18 to 1, the dissolved oxygen was not reduced below 50 per cent saturation, so that there was no injury to fish life. Moreover, at a point $1\frac{1}{2}$ miles below the outfall the water had recovered its oxygen and was again fully saturated. This means that under these conditions 731 lbs. of the dissolved oxygen in the river was used up every 24 hours in oxydising the organic matter brought in by the sewage effluent. On the other hand, during its flow for the next $1\frac{1}{4}$ miles, 708 lbs. of oxygen was extracted from the air in the process of natural re-oxygenation to make good the previous loss. This is an excellent concrete example of the process of self-purification in rivers.

Bacteriological Results

With regard to the bacteriological aspect, it is clear from the results of the examination of the first three samples that, although the chlorine added to the sewage effluent was only an average of 4.5 parts per million, and the destruction of the bacillus coli could not have been complete, the discharge of the sewage did not cause an increase of these organisms in the river water when the ratio of dilution was high. On the other hand, in the case of the last three samples, the addition of even nine parts per million of available chlorine to the effluent did not destroy all the bacillus coli, as a considerable increase of these organisms in the river water was found 300 yds. below the outfall. As in the case of the dissolved oxygen, this increase had disappeared at a point $1\frac{1}{2}$ miles below the outfall, where the condition of the river water was exactly the same as above the outfall. As to the cause of this recovery from the bacteriological point of view, the author has no suggestion to make, but hopes that it will be explained by the bacteriologists. As the services of the author were retained by the War Office to inspect and report upon these works at intervals after they were completed, and this arrangement still continues, it is hoped that further evidence will be obtained in due course as to the quantity of chlorine necessary to destroy all the coli organisms in the effluent.

On the whole, it is evident that the ratio of dilution—viz., 40 to 1—suggested by the Royal Commission on Sewage Disposal in Table B, page 11, of the eighth report, for an average septic tank liquor discharged into a rapid river fully saturated with dissolved oxygen is a safe basis to adopt. That, in the present case, the dissolved oxygen was not reduced below 50 per cent saturation, even with so low a dilution as 18 to 1, was probably due to the sewage being fresh and not septic.

General Conclusions

Having described the scheme in detail, the author desires to state that, although the working of the tanks may at first sight appear to be somewhat complicated, it is not so when once they are brought into regular operation. At the outset the author prepared a detailed set of instructions, and these have proved to require very little modification after $2\frac{1}{2}$ years' operation. At the same time, everything depends upon careful and intelligent management, and much of the success obtained has been due to the unremitting attention and capable handling of the present manager.

In conclusion, the author wishes to express his indebtedness to the War Office authorities for permission to publish this description and to use the analytical data given in the tables.

[This paper was read by the author before the Institution of Sanitary Engineers (England). Editor.]

CHEMICAL ANALYSES AND BACTERIOLOGICAL EXAMINATION OF RIVER WATER.
"A" = above outfall. "B" = about 300 yds. below outfall.
"C" = about $1\frac{1}{2}$ miles below outfall.

Sample taken.	Chlorine.			Dissolved Oxygen.			Bacillus Coli.			Ratio of Dilution.	Chlorine added.
	"A"	"B"	"C"	"A"	"B"	"C"	"A"	"B"	"C"	Water: Sewage.	Parts per Million.
	Parts per 100,000.						Present in c.c.				
1917											
Oct. 23 ...	1.0	1.2	1.1	1.10	1.13	1.12	0.01	0.01	—	137 to 1	4.4
Oct. 25 ...	—	—	—	—	—	—	0.01	0.01	—	142 to 1	4.3
Oct. 27 ...	—	—	—	—	—	—	0.01	0.01	—	180 to 1	4.9
Nov. 7 ...	—	—	—	—	—	—	—	—	0.01	—	—
1918											
June 18 ...	1.45	1.5	1.5	1.1	0.52	1.02	0.01	0.001	0.01	18.4 to 1	9.03
June 19 ...	1.45	1.5	1.5	1.1	0.59	1.03	0.01	0.001	0.1	18.7 to 1	9.52
June 21 ...	1.40	1.8	1.7	1.09	0.59	1.02	0.1	0.001	0.01	19.1 to 1	9.20

ways a considerable volume of water with a high current velocity at this point, so that the effluent becomes thoroughly mixed with the water in a short distance.

Effect of Sewage Effluent Upon the River Water

Dealing first with the physical effects, it can be stated that at no time has it been possible to detect any objectionable odours from the water or any deposits of organic matter either in the bed or on the banks of the river.

The chemical and bacteriological effects are shown in the results of the analyses and examinations which are set out herewith in tabular form.

It will be noticed that in all cases the river water above the outfall—i.e., before receiving the sewage effluent—is fully saturated with dissolved oxygen. At the same time it also contains evidence of previous pollution in the presence of bacillus coli. It is unfortunate that it has not been possible to make analyses when the dilution was somewhere near the 50 to 1 ratio, which was taken as the basis of calculations when the scheme was prepared.

With a good volume of water, as in October, 1917, the discharge of the sewage effluent causes practically no alteration in the character of the river water. Even during extremely low water, as in June, 1918, when

Inspection of Materials Before Acceptance

Failures Often Caused by Neglect to Have Concrete, Sand and Stone Properly Tested for Quality Before Use

By Emmanuel Mavaut*

ONE often wonders why it is that so many engineers and architects seem averse to having their building and structural materials inspected and tested before accepting them for use in their work. Too often this is omitted during the construction of high priced dams, bridges, breakwaters, office buildings, theatres, etc., where the professional reputation of the engineer or architect, the capital of the investor, and, quite frequently, the lives of many people are at stake.

Is it through ignorance, or is it through jealousy and selfishness that no other engineer or chemist is wanted to share the credit for the appearance or assured safety of the structure? Or is it through a mistaken sense of economy? We will review these points one by one.

Is it through ignorance? I may answer that in quite a few cases it is. Engineers of high standing have deliberately claimed to me it was not necessary to test anything, using as an argument that cement was standard, that any experienced man could tell good sand at sight, and that, as far as stone was concerned, limestone was limestone and that was all there was to it. These men start the work without knowing the quality of the materials they are using, and too frequently their structures fail. If it is concrete, the mass crumbles, disintegrates, cracks, or otherwise goes to pieces, and the average person who sees it concludes that, after all, concrete is a poor investment.

Defects That May Cause Failure

Let us review the arguments of these engineers. They claim that cement is standard. I say it is not, though I know the cement manufacturers, especially the larger ones, do all in their power to have the cement not only up to specifications but as nearly perfect as practically possible. But the chemist and superintendent cannot be all over the works at once, and, for that reason, there is always a possibility though it may be remote, of the cement coming out too fresh, too high in sulphuric anhydride, or in magnesia, or too low in specific gravity. These defects, which cannot be found without having the cement tested, will cause many different troubles in concrete work. For instance, one defect is, it will take its initial and sometimes its full set before being placed on the job, or, in other words, while the men are mixing it. In this case, there will be no cementitious qualities between the different lumps of concrete as it breaks up when being deposited, and so many stones covered with mud might just as well be thrown into the forms; the results would be as good.

On the other hand, another defect might cause the concrete to set too slowly. This naturally retards the work, because the form cannot be taken off as quickly as planned. If the risk is taken and the forms removed, there is a great possibility of the structure failing. If slow setting cement is used in the winter time and freezes before it sets, the concrete will soon disintegrate. Even if it should not totally collapse, it will be

a constant cause of expense for repairs and an ever present eye-sore.

Concrete Set Too Quickly

I had occasion, some time ago, to condemn eighteen cars of cement containing over sixteen thousand bags and amounting to over eleven thousand dollars in value. These eighteen cars, which had been purchased by two of our largest Canadian manufacturing firms, were condemned for the reason that the setting took place in from eight to twenty minutes. It should take at least one hour as determined by the Gilmore needle. Had not that cement been tested, it would naturally have been used, and, without a doubt, the work would have failed because of the concrete setting before being placed.

Outside of this particular case, I have had occasion to condemn cement quite a few times in different parts of the country. In the majority of cases, the cement manufacturer was not to blame for these failures in cement, but either the railway company or the contractor was responsible. Cement is often stored in unsuitable sheds where dampness and rain injure it. How many of us have not seen bags that were set as hard as rock taken out of temporary storage sheds? In such an instance, while only certain bags may be unusable, many others, and frequently a very large quantity, have been affected to such an extent that they should not be used.

Insufficient Protection

Another instance came to my personal attention last summer. An electric power development company situated in the province of Quebec, was about to raise their dam. The cement was purchased and stored beside the falls in an enclosure with no front. After this was filled with cement, a few boards were put up to protect the cement from the spray of the falls; but cracks ranging from one to ten inches were in evidence. The result was that the spray reached many of these bags of cement, making some of them so hard they had to be broken up with shovels before using. I drew the attention of the superintendent to this fact, but his answer was that the cement was first class. It stands to reason that had this cement been tested before using it would certainly have been condemned, as chemical action had already taken place, rendering it of little value. This is but one of the many cases where the cement company was not to blame, and similar instances occur almost daily; but, whether the manufacturer or the contractor is responsible, if the cement is not tested, and the work supervised by an experienced concrete inspector, the investor is likely to suffer.

Good Sands Cannot be Seen at a Glance

Now let us go into the sand question. It is claimed that any engineer or experienced man can tell good sand at a glance. That is impossible. He may be able to tell that it is too fine, if it is very much too fine, or too dirty, if it is very much too dirty. Beyond that, however, there are no engineers or experienced men who can tell at sight whether this sand or that is good and reliable for strong and dense concrete work.

All sand contains more or less silt or dirt. The reas-

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on for this is that it is composed of small particles of broken rock, of different sizes and compositions, coming from different parts. These particles have been washed away or transported from their different sites at different times and settled in layers of different thicknesses in what is now a workable sand bank or deposit. Therefore, there is no guarantee or even likelihood of uniformity, and one car load of sand may be first class and the next of very poor grade for concrete work. Also, the dirt and silt, which is very often injurious to sand for concrete purposes, are bound to be present in some parts of the sand bank, because the small particles of rock that are washed towards the bank will naturally carry with them more or less of this fine material. This shows conclusively that, in order to be sure of good results, the sand should be tested, not only once, but continually while the work is in progress.

Grading of Sand is Important

Besides the avoidance of injurious silt, there is the size or grading of the sand to be considered. It should be well graded, having a certain proportion retained on each sieve from, say, the eighty mesh to the one-quarter inch sieve. If all of the sand grains are of nearly the same size, the voids will be too great, and, unless an additional amount of cement is used, the voids will not be filled. If too fine, the concrete will not be of the required strength. The reason for having sand well graded is so that the fine particles will fill the voids of the coarser particles, thus reducing them to a minimum.

In order to properly proportion a concrete mixture, it is necessary to determine the voids. Without this information, the engineers are working blindly and probably wastefully. Where they are figuring on having a good dense concrete for a reservoir, oil tank or foundation, the results are apt to be different, and if the water goes through the wall, concrete once more gets a black eye.

Another very bad fault in some sands, which cannot be determined without testing, is that they contain injurious chemicals. Sometimes the drainage from some industrial plant such as a chemical works; soap factory or tannery, though located several miles away, will contaminate a sand supply, rendering it unfit for use in making concrete. As a rule such contamination is discovered by making three-to-one briquettes with the sand under consideration and also with standard sand. A comparison of the results will soon tell whether or not there are injurious chemicals present.

Sand Containing Injurious Chemicals

Some years ago, I had occasion to deal with a very interesting case of the above type. A company decided to build a concrete laundry building in Eastern Ontario on the site where an old stable had been standing for years. They tore down the old building and, in excavating for the cellar of the new building, ran across such nice looking sand that they decided to use it in the concrete mixture for the new structure. They had no end of trouble. The concrete would not set, and the walls fell in.

In carrying out an investigation, it was found that briquettes made of this sand would crumble in the hand after seven days setting. These briquettes were so disintegrated that they could not even be put in the machine to test. An analysis was made, and we found that the sand was saturated with ammonia which had percolated from the horse manure. As a result of this

investigation, the sand had to be taken away from the site of the work, the old concrete thrown out, forms rebuilt, new sand purchased, and the work reconstructed. All this delayed the work, cost money for material and labor to replace that wasted, and inconvenienced the owners. A sensible programme of testing would have prevented any of this trouble.

I would venture to say that three-quarters of the failures in concrete are due to poor sand. In spite of this some engineers will not hesitate to state that it is unnecessary to have sand tested.

As far as stone is concerned, the same argument holds as in the case of sand. In order to regulate the mixing of concrete, the voids must be determined, and in order to get good results, the stone must be clean, strong, well shaped, and well graded.

Extent of Inspection

It might well be stated that the best argument for the general inspection and testing of all building and structural materials is that every large corporation such as the Canadian Pacific, the Grand Trunk, the Canadian National Railways, the Montreal Tramways, the Montreal Light, Heat and Power Company, the Harbor Commissioners of Montreal, Toronto, Hamilton, London, Peterborough, the departments of the government, provinces, states, the counties and municipalities that are at all progressive, and large private concerns too numerous to mention, all have their materials thoroughly tested before using. The sooner other engineers and architects make up their minds to have testing and construction supervised by experienced men, the sooner eyesores, failures and constant repairs to concrete work will stop.

Is it through selfishness? I happened to interview the city engineer of one of the larger cities of Canada on the subject of supervising concrete construction and the testing of materials for same. After a long conversation, he agreed that the construction materials should be tested, but turned around and said: "Where do we come in. The testing concern will be the party doing the work, and getting the credit. The municipal council will say, 'These engineers of ours are no use if they must get their materials tested and work supervised.' If we were to do that, we might find ourselves out of a job."

A Series of Troubles

Whether it is the effect of the above policy or not it is hard to say, but this particular city has had constant trouble and very heavy expenditures for replacing defective work which expenditure has, of course, fallen upon the taxpayer. They erected a fat stock show building, and the whole thing collapsed. Their water main cracked and, as it was a suction system, sewage, polluted water, and so forth, was sucked into the mains and contaminated the drinking water. This caused a typhoid fever epidemic that carried off almost a thousand people, and forced the city to open emergency hospitals that it had to furnish and provide with doctors, nurses and orderlies. The boiler in one of their municipal buildings exploded, killing one man, injuring others, and wrecking the building. A pavement about twenty-five city blocks in length took on the form of a corrugated road, and had to be relaid a few years after it was first put down.

It goes without saying that all this trouble cost the city many thousands of dollars, which expense might, and very likely would have been avoided had all the materials used in these constructions been tested and

the work supervised by some one particularly familiar with each type of construction. Any possible loss of prestige to any engineer or architect through the employment of outside specialized inspection and testing service could not conceivably injure him as much as one such failure as we have mentioned. In fact, after the failure, some one will ask why he did not have knowledge enough to understand that he needed such specialized service.

Misplaced Economy

Is it through an economical point of view? With some engineers and architects it is. A good many of them will say that this or that work is not of sufficient importance, or will not be seen, and that the spending of money on tests is a waste. This is very unwise economy, in fact, not economy at all. It is a case of saving the pennies to throw away the dollars, for when

the construction materials are tested and accepted by specialists, and the work supervised by them, the engineer or architect is practically relieved of all responsibility except that of having selected competent specialists to do the work. Besides, if his plan and specifications are correct, he is sure there will be no unwarranted expense for repairs, and the structure will be there to stay as a monument to his name and a foundation for his future reputation in the engineering profession.

The engineers and architects who are foremost in their profession would not consider for a moment the proposition to have their plans and specifications carried out without full inspection and testing as the work progressed. Therefore, why should men who have not yet reached the pinnacle of professional success risk failures that might forever preclude their attaining it?

Methods of Financing Highway Improvements

Eight Distinct Sources of Revenue—Motor Fees for Maintenance—Toll System Applicable in Certain Cases

By J. E. Pennybacker*

THERE are eight distinct sources of road revenues. These are: (1) personal taxes paid in labor and by an arbitrary annual fee known as a poll tax; (2) direct property taxes; (3) proceeds of registration and license fees on motor vehicles; (4) direct appropriations from general treasuries; (5) special assessments on property in road improvement districts and against property abutting and contiguous to a designated road; (6) sale of bonds; (7) appropriation by the National government; (8) collection of tolls, and (9) miscellaneous sources, such as, sales of lands, profits from state industries, taxes on corporations, sale of permits, etc.

It may appear from the foregoing that the public road reaches all of the possible sources of taxation and theoretically this is true, but practically the general trend of road finance is toward a reliance upon direct property taxes, motor vehicles revenues, sale of bonds, and Federal appropriations. The other sources are incidental and quite local in their application.

Statute Labor Suitable Under Certain Condition

The labor tax has been ridiculed and condemned at every good roads meeting during the past decade. It is unquestionably an inefficient and wasteful method, both of paying taxes and building and repairing the road, but it is probably the lesser of evils in localities where a large proportion of the population holds little or no property, is thoroughly accustomed to manual labor as tenants of farms and plantations, and can only be reached effectively for the performance of civic duties through the imposition of a tax upon their manual rather than financial capacity. I should consider, therefore, that it might be desirable to consider the retention of some form of statute labor tax where the local conditions are such as I have described.

The direct property tax for road purposes probably will always be necessary both as a source of revenue and as a means of reaching all beneficiaries of road improvement, but many reforms and improvements are necessary before this method of finance can be held to really serve its purpose equitably. It is well

known that the ratio of taxable to actual value varies not only among the states and provinces in a wide degree but in many of the states there is a wide variation among the several counties. Manifestly, if a state or provincial tax be levied for road purposes and the property in one county is assessed at 40 per cent. of its actual value, while the property in another county is assessed at 60 per cent. of its actual value, there is immediately an unjust discrimination against the latter county. The practice of equalizing assessments by boards of equalization should be vigorously urged in connection with the levying of taxes for road purposes.

Adjusting Direct Taxation Equitably

In some of the states, cities are not taxed for county purposes and consequently heavy automobile traffic from cities exerts a destructive influence upon country highways without any corresponding return in the form of taxes. The remedy is either to make the cities taxable by counties for road purposes or to include practically all of the heavily travelled highways in the state or provincial system and reach the cities by the direct state tax. It would seem to be fundamentally necessary that roads be classified and segregated into distinct systems as a condition precedent to the establishment of direct property taxes. Probably some budget plan could be worked out in which the requirements of the state, county and township highway systems respectively could be ascertained, and the total tax rate then adjusted so as to yield amounts proportionate to such findings. The net outcome would be that the man who lived on a state road would pay the heaviest tax, the man who lived on the county road the next heaviest, and the man who lived on the township road the lightest tax, but each instead of paying three distinct taxes would pay one.

For the reason that it is easier to convince the public of the necessity of building a good road than it is to convince them of the necessity of keeping it up, I would advocate dependence upon the direct property tax as far as possible for the construction of state or provincial roads and for meeting interest and retirement requirements on state bond issues, thus leaving

*Bureau of Public Roads, Department of Agriculture.

to motor vehicle fees the burden of first supporting state highway organizations and maintaining the roads, and applying only the surplus from such revenues to the construction of roads and the payments of principal and interest of bonds. For county and township roads, it will continue to be desirable and necessary to levy the direct property tax for practically all highway purposes, less such amounts as may be granted by the federal government and the states or provinces as aid.

Motor Fees for Maintenance

Proceeds of motor vehicle registrations and licenses have increased enormously during the past few years.

As suggested in the preceding paragraph, this revenue should first be applied to the support of state highway departments and to the maintenance of state highways for the reason that the revenues are regularly available without the irritation to the taxpayer which comes from levying a direct tax each year. In other words, having secured a good road, the average taxpayer is apt to consider the road as a permanent institution, and to resent the necessity of continuing to tax himself to keep it up, whereas, he is not so likely to oppose spending the generous motor vehicle revenues for this purpose. I believe, therefore, that it is a mistaken zeal which seeks to tie up motor vehicle revenues for the payment of interest and retirement of bond issues, thus leaving to the tender mercies of the taxpayer the roads built at great expense and for which debt has been incurred.

Questions as to the basis of levying the fees on motor vehicles are interwoven in a very intricate manner with questions of regulation looking to the protection of the highway so that the matter is not purely one of revenue. Thus far the tendency seems to be quite general to base the tax on the ordinary motor vehicle on horse-power at rates now generally regarded as equitable at anywhere between 40 cents and \$1.00 per horse-power. Motor trucks on the other hand, are more generally taxed on a weight basis. It would seem that there has been too much of a tendency on the part of each state to follow precedent. There ought to be good possibilities for the working out of an efficient and equitable basis of motor vehicle taxation through joint action of the best informed men in those state highway departments which have had most intimate contact with this problem. The findings of such a committee would be exceptionally helpful to all of the states.

Direct Appropriations and Special Assessments

Direct appropriations from general revenues are practicable in large and wealthy states or provinces and municipalities, but in view of the urgent necessity of carrying on highway construction and maintenance according to a comprehensive system and over a period of years, the dependence upon annual appropriations is too precarious to permit dependence upon this plan except for special and temporary purposes.

Special assessments in road improvement districts is a method of finance sometimes followed, and practically means the formation of a corporation of land-owners who voluntarily bring upon themselves taxation for the purpose of improving their property by means of better highways. This method has proven successful in obtaining improved roads which could probably not be obtained through dependence upon popular vote. It localizes the burden, however, and is

not equitable unless the road is of purely local importance. Any road used by traffic outside of the improvement district should have a wider field of taxation.

Bond issues for highway improvement are becoming popular at a rate which is not altogether reassuring. Certain fundamental questions, such as, the length of term of the bonds, their payment on a serial rather than a sinking fund basis, the rate of interest, the determination of the roads to be improved, the solving of the difficult problems of type and dimensions of roads, should be worked out ahead of the sale of bonds so that these vast outlays may not produce such niggardly results as to cause a re-action.

Toll System Has Certain Application

The collection of tolls, while generally tabooed by intelligent public sentiment, may yet assume a position of real importance in the financing of road work. In the old days objection was made to tolls because they were usually collected by private companies on public rights of-way, because the cost of collection was out of all proportion to the amount of revenue derived, and because it was impossible to prevent gross dishonesty. It is possible to meet these faults by having the toll collected by the state or province and not by private companies. Traffic has become so enormous as compared with the old days and automatic devices for collecting and recording collections have been so highly developed as to make it possible to collect tolls at the cost of a small percentage of the total collections. The destruction to the roads of one tax jurisdiction by traffic coming from other tax jurisdictions naturally directs attention to the toll system as one means of meeting this condition. The toll system is distasteful and inconvenient to the road user and may be made unduly expensive, but on the general theory that payment should be made for service rendered, it would hardly seem that the road user could legitimately object to paying for the benefit of using a good road. I am not prepared to advocate the toll system, but I consider that it should not be dismissed lightly as a relic of the barbarous ages.

Finally, the aid granted by the federal government has become of considerable magnitude. At present it is left to the state highway departments in the first instance to determine where the federal aid is to be expended. It would certainly seem that the national government should concern itself with those roads which are of national importance and in line with this conclusion, the granting of federal aid should be restricted to a national system, or at least to those roads which are interstate in character. If this be done, it will be one more step in the logical development of the principle of apportioning burdens to each unit of government according to the benefits derived.

The Williams and Wilson office and warehouse building described in the Contract Record of April 9, page 335, is equipped with steel sash. These were supplied by the Trussed Concrete Steel Co. of Canada, Ltd., Walkerville, Ont.

Mussens, Ltd., Montreal, have been awarded by the city of Montreal, a contract for an Elgin combined street sprinkler, sweeper and collector, for \$8,100, and an auto sweeper, for \$4,900, on the understanding that if the city decides to purchase six other machines from the firm, the price will be \$100 less per machine.

Being a Small Contractor and Making It Pay

THE problems of the small contractor—what are they? "Concrete" gives over a page or two to one great problem of the smallest contractor, that is money-making. Many a small contractor can do a good job but cannot make money, but perhaps this article, written by a small contractor, will offer suggestions along this line.

There is a whole army of us, what I call "gunny-sack contractors"—intelligent in our way, but with no technical knowledge. We take sub-contracts and small work, such as lawns, curbs, small retaining walls, steps and such.

Few of us make any money, or save any. We don't as a rule, use business methods in keeping account of just how we come out. We figure on jobs of from \$100 to \$500, and we don't think in terms of the little items that make up these amounts.

The little things that are neglected catch up with us, and generally, in the fall, we owe the material man. If we could learn to figure right, we'd make some money. As a rule we are the most practical and the most mechanical minded people in the business.

I have been in this game 16 years—all over the United States and other places. I have always been honest and paid my bills—but some of them were past due. Three years ago I learned how to make money, and I have been making it ever since. I have made enough so that next year I expect to retire on a section and a half of land. I did it by learning how to keep books. Now, all the bookkeeping I do is on little 3-in. x 5-in. ledger cards, and I have a card for each job. Here is the Jones job, for instance:

Jones Job.—1,300 sq. ft. floor, 15c—\$180.00.	
Wednesday	
Oct. 12. Labor, 5 men, 8 hours, 62½c.	\$ 26.70
Cement, 70 sacks, 85c.	59.50
Gravel, 20 yds., \$1.50.	30.00
Sand, 3 yds., \$3.00.	9.00
Mixer.	5.00
Dray.	2.50
	\$132.70
Overhead.	5.63
	\$138.33

When the card is first made for each job I simply put in the name of the person for whom the work is done, and the unit prices, everything being worked out on the basis of experience at so much per running foot, or so much per square foot. Then when the job is done, if a little job, on each night I take out the card, put down the items of cost as they have actually worked out, and make up my totals. When I make a profit, I put down the profit in red ink—red being a celebrating color—but if there is a loss on the job any old ink will do.

Not an Office System

After a while you get interested in this bookkeeping job as a sort of a pastime. It's a good deal more fun than a set of books that a man would have to keep in an office—and the busy small contractor is too busy to have an office to spend any time in.

The thing a contractor is most apt to forget is to

charge up something for the use of his equipment—if I pay \$600 for a mixer and don't have \$600 laid away when it is worn out, then I have lost money on several jobs where perhaps I thought I had a profit. I figure that about 30 per cent. of the money that I invest in equipment goes in wear and tear. This has got to be provided for on every job. Of course, an accountant could devise a fine system, but it would take a book-keeper to run it, and that's the reason my simpler method is better.

That item of drayage on my bookkeeping card is charged up because I have a truck which moves me and the crew from one job to another and keeps things picked up. I charge that item to the use of the dray, just the same as though I had to pay a drayage company to do the work, and the money that comes from this is put aside for repairs—a sinking fund for a new dray. On a small job, where a little mixer is used, I charge only \$2.50 for the use of the mixer. I have three mixers, and if I use the big mixer I charge \$6.00.

Of course, a lot of people figure that being a small contractor is only a step to being a big contractor, but I'd rather be a small contractor. A small contractor can make a lot of money if he figures right and is a good manager and has some energy.

If I should tell you of bringing out a season's business of \$38,000 gross, and making a net profit of \$9,000, you would think either that I got exceptionally big prices, or that I was handing out some bunk. I did it last year, in 1918. I did 102 jobs that would average around \$400 each. I have been very careful since I learned this bookkeeping game, on the little 3 x 5 cards, to separate each kind of work, such as basement floors, walls, sidewalks, or whatever I do on a particular job, into separate items, and make figures separately. I figure on the basis of what can be cleaned up in a day, and how many men it will take to do it, and I soon figure how I can get the most money out of a job, always working on the unit basis of so much per foot.

I don't employ a finisher, which is my chief item of saving. This work I do myself. I have done it for 16 years, which, as you know, is a long while in the cement business. I try to arrange always to get the top on so I can finish it in the evening after the rest of the crew is through, and the way I work a finisher's time is worth \$9 or \$10 a day.

In order to handle work this way, I keep a good man ahead of me, getting the jobs ready, so that when I move up and tune up the mixer, I slam in the mud.

Money for Cement, Instead of Railroad Fare to Escape

I never cut material—that's the most expensive thing there is. No use stealing cement from the man you get the work from to give the money to the railroads to keep you away from your bad jobs.

I have one way of figuring, and all my customers get that way. Some people just tell me to do the work and get the price afterwards. They get just the same price as though I had given the figure in advance. A general contractor will usually give me a shade the best of my competitor in figures. If a fellow can once establish his honesty, it is the greatest asset he can have. But now to get down to cases.

There is the job done for Mrs. Adam Saver. This is an actual job, even if the name is a fake, but an exceptional job in the fact that the profit on it was bigger than ordinary. The figures and all the bookkeeping on this job are shown on the card.

When I take a job like that I set down a figure that

will let me get just so much out of it in dollars and cents in conjunction with good work. The overhead item covers wear and tear on forms, nails, and small tools. It's the little things that contractors overlook that eat up the profits that they think they are making.

They deal in round sums, when they make the bids, and they somehow can't think in the little items that make up those sums. After all, it's the little sums that make up the bank account.

If the little sums aren't watched and set down on paper at the time, they get away and at last they crowd a man right out of business.

Of course, a man who works on the job all day and hasn't any office is apt to let the bookkeeping go and forget to record the little items; when he comes home at night he is tired and leaves his bookkeeping till some other time.

My work mostly consists of house foundations, floors, walls and steps—in other words, fixing up dwellings. I try to push off the city contracts—in fact, all public lettings, on to my competitors. That sounds funny, but I have tried it from all angles, and I think I know where the sure money is.

I guarantee my work not to crack. I laid seven miles of sidewalk and offered \$100, two years afterwards, to anyone who could pick out a cracked stone. That was a good ad—but I played safe when I did the job in the first place. But, of course, there are a lot of us gunny sack contractors who can do good work—the trouble is we can't figure it right.

Another thing is to keep busy—keep things humming on schedule. The way I keep this small work going fast is to keep a good foreman ahead of the concreting crew, and give this foreman all the help he needs. He gets ready, even to laying the planks for the runways. When I come up with the machine I put the concrete in without any delay. Each man knows his own work. Instead of trying to be a big contractor with several superintendents and foremen and running a number of jobs, and spending most of my time at contract letting, I can make more money the other way; but there is no use in bringing your mixer on the job and let it stand while you get ready to use it—that's why I send the foreman ahead. As far as the finishing is concerned, that is the easiest part, as I can finish 1,000 ft. of floor in a few hours—say two hours and a half—and I generally arrange to do that after five o'clock.

By doing this work myself, instead of running more than one crew, I can keep in close touch. If I try to expand my business into a new field of work and be a big contractor, I would have to take big work, go to public lettings, and generally waste time that is worth at least \$30 a day to me.

Takes Only Such Work as he Himself Can Help With and Look After

But I have tried it. I took a job of 60,000 feet of sidewalk in a nearby town; sent a man—who had worked for me two years and was a good man—out to look after it. He came out that fall with a "break even"—nothing to pay me for my time or mixer, tools, or anything—just broke even on the actual work. I let him go this year and I went back and finished 18,000 feet of that job, in the face of a 30 per cent. increase in prices, and came out with \$710 of a clear profit, not counting my own time. So you see there is a difference in management.

Mason Contractors' Association Will Meet

The Mason Contractors' Association of the United States and Canada has arranged for a conference to be held in Indianapolis, Ind., on May 6 and 7. At this meeting the question of a standard agreement between the bricklayers and the contractors in both countries is to be brought up, and a plan of payment for estimating is also to be discussed. Two Canadian representatives will attend the conference—Mr. H. Elgie, of Toronto, and Mr. Harry Hayman, of London.

Mainly Constructional

East and West—From Coast to Coast

The Bricklayers', Masons' and Plasterers' Local Union, in Fredericton, N. B., is demanding an eight-hour day with 70c an hour wages. The present rate for the nine-hour day is 60c.

The Carpenters' Union in Hamilton, Ont., is asking a 40-hour week with 75 cents an hour wages, effective May 1st. At present they receive 60 cents and work 44 hours per week.

The men of the Painters' and Decorators' Union in Toronto have gone out on strike. They are demanding 65c an hour wages. At present the rate of pay is 55 cents and 50 cents.

The special housing committee in Hamilton, Ont., recommends that a survey be made of the north end of the city for the purpose of finding out what sites are available for workmen's houses.

The Toronto Carpenters' Union is demanding 75 cents an hour and a 40-hour, five-day week, effective on June 1st. At present the carpenters are receiving 65 cents an hour and work 44 hours per week.

There is considerable uneasiness in the building and allied trades in Halifax, N. S., and it is feared that there will be a strike after May 1st. The men are asking that their wages be increased to 75 cents an hour. An eight-hour day is also being demanded.

Negotiations have been completed whereby Hyatt Steel Products, Limited, of Granville Island, Vancouver, takes over Canadian Metals, Limited, Tudhope Electric Metals, Limited, and the Steel Rolling Mills at Port Moody. Under this amalgamation, the new concern becomes one of the largest iron and steel industries in Western Canada. It is proposed to engage in the manufacture of steel, operating a 3-phase, electric-arc, 6-ton furnace, of 1,500 k.w. capacity. The ingots will be produced at the Tudhope plant on False Creek, where successful tests have been made, and will be rolled at the Port Moody mills. The company will also continue the production of babbitt, solder and type metals.

It is now stated that plans for the tunnel under the English Channel between France and England are so far advanced that the work of construction may be started at once. The cost is estimated at a billion dollars or more. The tunnel will be 32 miles long, more than 21 miles of that distance being under the sea. The entrance to the tunnel will be northwest of Dover, some miles from the coast because of the huge cliffs between Folkestone and Dover. Two tubes each 18 ft. in diameter are to be sunk, with cross galleries every 200 yards. The deepest water along the route is 180 ft. and it is proposed to go deep enough to have a cover of the chalk sea bottom 100 ft. thick between the top of the tunnel and the bottom of the channel. The first layer under

the channel is white chalk. Below this is 200 ft. of gray chalk and through this the boring will be made. Besides the main tracks, the tunnel will carry telephone and telegraph wires and pneumatic tubes for the dispatch of letters and parcels. Trains will be operated by electricity and the time of crossing the channel will be 45 minutes. The trip from London to Paris will take but six hours.

GOOD ROADS ACTIVITIES

Mr. W. A. McLean, Deputy Minister of Highways for Ontario, addressed a meeting of farmers of Peterboro county recently regarding the advantages of adopting a county road system under the Ontario Highways Act. Peterboro is the only county in the province which has not yet taken advantage of the provisions of the Act. There are, however, a number of municipalities in the county which favor such action. North Monaghan has recently passed a resolution petitioning the Ontario government to assume the road from Peterboro to Port Hope as a provincial highway.

A delegation representing Waterloo county, Ont., recently came before the provincial Minister of Public Works and Highways petitioning for certain road undertakings in that county. It was suggested that a provincial-county road be built from the Wentworth county line through Galt, Preston, Kitchener and Waterloo to Elmira, and that the Dundas and Waterloo road should be extended to Guelph through Galt and Hespeler, as a provincial-county road. Failing the construction of a provincial highway from Toronto through Guelph, Kitchener and Stratford, it is petitioned that a provincial-county road should be constructed connecting Kitchener and Stratford.

Trade Incorporations

Crowe's Iron Works, Limited, head office Guelph, Ont., capital \$200,000.

Stickney Motors, Limited, head office Peterborough, Ont., capital \$1,500,000.

H. H. Symmes & Co., Ltd., head office Montreal, capital \$25,000. Authorized to carry on business as builders and contractors.

Personals

Mr. R. J. Lecky, general contractor, of Regina, has reopened his offices in that city, having received his discharge from the army.

Mr. Joseph N. de Stein has joined the staff of the Parsons Engineering Co., Regina. Mr. de Stein was formerly resident engineer of the G.T.P. Ry. at the same point.

Mr. Ivan E. Vallee has been appointed, by the Quebec government, provincial chief engineer and director of railroads, and also engineer of the Quebec Public Utilities Commission. He succeeds his father, the late Mr. L. A. Vallee, in these various capacities.

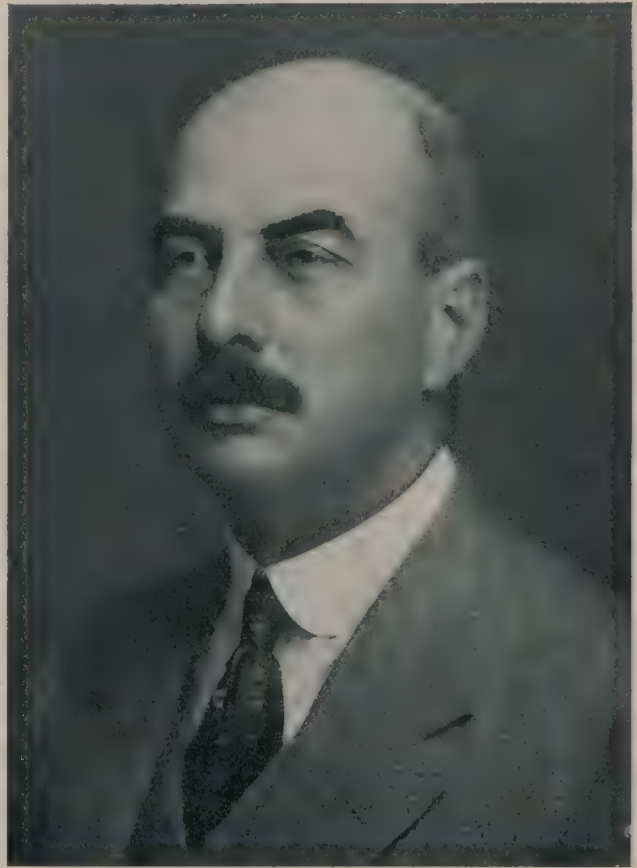
Mr. Robert McKenzie, former building inspector for the city of Vancouver, who, as mentioned in a previous issue, is taking up construction work in China, was made the recipient of a presentation by the Master Builders' Association of Vancouver, on the occasion of his departure.

Major-General F. O. W. Loomis, who has returned to Canada, is a partner in the contracting firm of D. G. Loomis & Sons, Montreal. He has had a distinguished military career, being mentioned six times in dispatches. Major-General Loomis has been awarded the C.B., C.M.G., D.S.O. and bar, the Legion of Honour (France), and Order of Leopold (Belgium). He was promoted to Brigadier-General in 1916 and to Major-General in 1918.

Mr. A. K. Grimmer has been appointed town engineer

for the development of the town of Temiskaming for the Kipawa Co., Ltd. Mr. Grimmer, it will be recalled, was formerly city engineer of Medicine Hat, Alta. Later he went to take up consulting work in the Maritime provinces and located at St. Andrews, N. B. Just previous to accepting his present position, he was connected with the Bate-McMahon Maritime Co., at Halifax.

Mr. Chas. O. Stillman who, as announced in our last issue, succeeds the late Hon. W. J. Hanna as president of the Imperial Oil Co., has been vice-president of the company since 1911. Mr. Stillman is a native of Cleveland, Ohio, and is 55 years of age. In his boyhood he entered the employ of the Standard Oil Co. as an office boy, and worked his way up in the firm till in 1890 he was made superintendent of their Buffalo plant. In 1897 he went to Sarnia, Ont., as superin-



Mr. C. O. Stillman

tendent of the Bushnell Co., Ltd., and while there had full charge of the planning and construction of the Imperial Oil Company's plant. In 1899 he was appointed a director and superintendent of the Imperial Oil Co., Ltd., of Sarnia, being promoted in 1901 to the position of general superintendent, and in 1910, to assistant general manager. In 1911 he became vice-president, and three years ago came to Toronto. Mr. Stillman was also elected president of the Imperial Pipe Line Co., and president of the Queen City Oil Co., in 1914. He is a member of the Toronto Board of Trade.

Obituary

Lieut. Frank W. Glover, formerly municipal engineer of Murrayville, B. C., died recently in England following an operation for appendicitis.

Mr. John Marr, who for the past 35 years has carried on a building and contracting business in the west end of Toronto, died on April 21st at his home at Mount Dennis, having reached the advanced age of 77 years.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Alexandria, Ont.

Road work will start soon for Town Council. Engineer, Wm. Ritchie.

Barrie, Ont.

Work will start soon for sewer on Maple Ave., for Town Council. Engineer, C. Tymon.

Guelph, Ont.

Plans will be prepared for resurfacing pavements for City Council. Engineer, F. McArthur.

Highgate, Ont.

Plans will be prepared for tile drainage work. Township clerk, N. Littlejohns.

Point Grey, B.C.

Municipal Council plans construction of roadway on Matthews Ave. Engineer, W. B. Grieg.

Ridgetown, Ont.

Tenders received by clerk, Geo. McDonald, until May 3rd, for supplying material and constructing three concrete culverts for Township Council.

Sherbrooke, Que.

Tenders received by city clerk, E. G. Gatién, until noon, May 12th, for extensive paving throughout the city.

St. Lambert, Que.

Tenders will be called soon by sec.-treas., A. R. Lafleche, for construction of water-bound macadam roads for City Council.

St. Romuald, Que.

Tenders will be called soon by secretary, Arthur Pigeon, for construction of water-bound macadam roads, 6,060 ft. long, for County Council.

St. Thomas, Ont.

Tenders received by engineer, M. Ferguson, until 5 p.m., May 2nd, for approximately 13,000 square yards of macadam road and 11,000 of curbs and gutter for Town Council.

South Vancouver, B.C.

Municipal Council plans road paving and repairs on various streets, cost \$91,000. Sec.-treas., W. T. Riley.

Victoria, B. C.

Department of Public Works, Victoria, plans construction of trunk roads, cost \$1,500,000, throughout the Province. Minister, Hon. J. H. King, Victoria.

Welland, Ont.

Work will start on road repairs, \$75,000 to \$100,000, for County Council. Superintendent, W. W. Brookfield.

CONTRACTS AWARDED

Montreal, Que.

Sewer, cost \$9,800—City Council has

awarded contract to J. Allen Bray, St. Dennis St.

Railroads, Bridges and Wharves

Chilliwack, B.C.

Work will start soon for freight sheds, cost \$5,200, for C. N. Rly., Toronto. General manager, N. H. MacLeod, Winnipeg.

Lindsay, Ont.

Tenders received by county clerk, J. R. McNeillie, Lindsay, until 5 p.m., May 6th, for material and building two bridges.

Ottawa, Ont.

Canadian Government Railways, Toronto, plans erection of station. Secretary, J. W. Pugsley, Ottawa.

Three Rivers, Que.

Board of Harbor Commrs. plans repairs to wharf. Secretary, A. Desilets.

CONTRACTS AWARDED

St. Andre, Que.

\$3,500 bridge for Town Council. General contractor, A. Doris, Oka, Que.

Toronto, Ont.

Abutments and culverts for Canadian National Railways, 27 Wellington E.: General contractor, Jas. Bogue, 220 Dublin St., Peterboro.

Abutments and culverts for C. N. Rlys.: General contractors, Pellsworth & Daly, Cobourg.

Abutments, piers and culverts for C. N. Rlys.: General contractors, Campbell & Long, C. P. R. Bldg.

Public Buildings, Churches and Schools

Alexandria, Ont.

Tenders will be called in May for erection of \$75,000 hospital for Archie Chisolm.

Biggar, Sask.

Plans are prepared for hospital and nurses' home, cost \$25,000, for Town Council. Clerk, H. A. Crawford.

Chatham, N.B.

R. C. Congregation plans erection of \$80,000 college to replace one destroyed by fire.

Dinsmore, Sask.

Plans are prepared for hospital and nurses' home, cost \$25,000, for Municipal Council. Sec.-treas., R. H. Popplewell.

Elora, Ont.

By-law will be voted on shortly for erection of \$30,000 school for School Board. Secretary, C. W. Stockford.

Elrose, Sask.

Plans are prepared for hospital and

nurses' home, cost \$25,000, for Municipal Council. Sec.-treas., Fred. Ludlow.

Georgetown, Ont.

Work will start soon for church for R. C. Congregation. Architects, Chapell & Hunter, Des Brisay Bldg., Charlottetown.

Glenavon, Sask.

Plans will be prepared for \$12,000 school for School Board. Prices wanted on all materials. Secretary, S. J. George.

Hamilton, Ont.

St. Margaret's Anglican Church plans erection of church. Rector, Rev. A. N. Barklay, 120 Homewood Ave.

Kamsack, Sask.

Tenders will be called May 5th for erection of \$7,000 church for Presbyterian Congregation. Architect, Storey & Van Egmond, 1013 McCallum Hill Bldg., Regina.

Leamington, Ont.

School Board plans erection of \$25,000 school. Secretary, J. McR. Selkirk.

Montreal, Que.

Plans are in progress for club house for Whitlock Golf Club. Architect, Geo. D. Wood, Royal Insurance Bldg.

Plans are in progress for synagogue for Congregation B'Nai Jacob. Architect, C. Dufort, 195 St. Catherine St. E.

Ottawa, Ont.

Tenders received by deputy superintendent, Duncan C. Scott, until noon, May 28th, for erection of two schools at Tyendinga and Whitefish Indian Reserves, for Department of Indian Affairs, Ottawa.

Outremont, Que.

Plans are in progress for presbytery for Parish of St. Madeleine D'Outremont. Architects, Bigonnesse & Bigonnesse, 60 Notre Dame St. E., Montreal, will call tenders end of May.

Point Grey, B.C.

Plans are in progress and tenders will be called soon by architect, R. P. S. Twizell, 837 Hastings W., Vancouver, for addition to school for School Board.

School Board plans erection of two \$80,000 schools. Architect, R. P. S. Twizell.

Portage La Prairie, Man.

Plans are in progress for altering hotel for community building, cost \$4,000, for Municipal Council. Architect, Frank R. Evans, Confederation Life Bldg., Winnipeg.

St. Catharines, Ont.

Plans are prepared and tenders will be called May 18th, for erection of two \$65,000 schools for Public School Board. Architect, A. E. Nicholson, 46 Queen St.

St. Come, Que.

Tenders will be called when plans are completed for chapel for Parish C. n-

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An Example to Canadian Public Authorities

A RESOLUTION has been passed by the Toronto city council that "during the period of reconstruction, no contract for the construction of any public work on the highways, undertaken by the city, shall be awarded to any persons or companies that were not bona fide residents or ratepayers—who are British born or naturalized British subjects—in the Dominion of Canada continuously since 1914."

The great majority of Canadians, we believe, will approve this attitude and the example is one that other towns and cities throughout the Dominion should follow. It certainly seems that it is incumbent upon our administrative authorities, municipal, provincial and federal, and upon our public institutions, which are supported by our heavily burdened taxpayers, to see that when money is to be expended upon construction work, Canadian employers and Canadian workmen

should reap the benefit. Then why confine it to high-ways?

Construction Interests Not Represented on Montreal Housing Committee

ALTHOUGH the committee named by the Administrative Commissioners of Montreal to carry out the industrial housing scheme is composed of men of the highest standing, it lacks a representative of the construction interests and to that extent is incomplete. The chairman is Mr. Beaudry-Leman, general manager of the Bank of Hochelaga, and formerly in practice as an electrical engineer; the other members are: Dr. de Lotbiniere Harwood, dean of the Laval medical faculty, and president of Notre Dame Hospital; Commander J. K. L. Ross; Chas. S. Campbell, K. C.; and Alphonse Verville, city commissioner. The latter will represent the labor interest. The commissioners received a large number of names and nominees of various societies, and as it was impossible for all the interests to be represented on the committee, the Commissioners have apparently gone outside the various societies and selected independent men. The work is voluntary. The committee will appoint a general manager, who will be responsible for all the actual building operations, and the committee will also have power to call in various experts to assist in settling details of schemes.

British Columbia Plans Comprehensive Road Development

IT is probable that the greater part of the emergency vote of \$1,500,000 passed at the recent session of the British Columbia legislature will be appropriated for road work. The general "Good Roads" programme was recently outlined by the Provincial Minister of Public Works. On the mainland the policy of improving trunk highways will be as follows: There are certain trunk roads leading out of Vancouver and New Westminster which are much travelled thoroughfares. At the present time these being macadamized roads, it is not possible to maintain them efficiently, and it is therefore proposed to devote an amount to hard-surface some of the more important ones, particularly the Pacific Highway. Work is also to be undertaken as follows in the various districts of the province: Dewdney and Chilliwack districts—work will be confined to the trunk roads and also to the construction of an industrial road into the oil plant at Ioco. Yale district—it is proposed to complete the one-mile road between Merritt and Princeton. Kamloops district—the expenditure will be on the trunk roads known as Kamloops-Savona and the Kamloops-Falklands roads, general improvement being necessary. North Okanagan district—improvements will be carried out on the Enderby and Okanagan Centre road and also on the Falkland-Vernon road. South Okanagan—present trunk road to be improved and resurfaced and the curvatures widened. Similkameen—similar work to that to be undertaken in South Okanagan. Boundary country—trunk roads to be improved and survey made to connect up the Kootenay districts; if a feasible route can be obtained between Paulson and Rossland, construction will be carried out during the coming season. Trail and Nelson districts—four miles of road to be constructed between Thrums and Brilliant; Nelson Ymir road also being given consideration. Slokan dis-

trict—old road between New Denver and Slocan to be rebuilt. Kaslo district—Kaslo Ainsworth road to be completed, and construction of five or six miles of road between Sirder and Kuskanock, using the right-of-way of the Great Northern Ry., also being considered; East Kootenay country—to improve main trunk highways running through Cranbrook, Fernie and the Columbia districts; Revelstoke district—roads from Mara Lake through to Taft and Boulder Creek to be built; Lillooet district, roads to be built opening agricultural and mining districts; Cariboo district—main trunk roads to be improved; Fort George, Peace River and Omineca districts—trunk roads to be improved and new roads to be built to serve agricultural districts; Atlin district—roads to be built to serve mining areas.

Costs of Operation Decline Without Reduction in Wage Scale

THAT a reduced wage scale is not an indispensable preliminary to resumption of activity in the building trades is the opinion of M. C. Tuttle, expressed in a recently issued pamphlet. Mr. Tuttle, who has just returned to Boston after more than a year of service as production manager for the United States Emergency Fleet Corporation, bases his judgment on some very recent investigations of large construction enterprises located at various points from New England to Florida, supplemented by careful studies carried out under his direction by the Aberthaw Construction Company of Boston, of which he is general manager. These unmistakably indicate that increased efficiency of labor is bringing down costs even while wages remain at existing altitudes.

"In the course of viewing numerous undertakings more or less closely associated with interests of the government," says Mr. Tuttle, "I have lately been impressed to find the statement commonly made that costs of operation are beginning to show a noticeable decline. And this, almost without exception, was attributed to increased efficiency of the labor force, due in part to the opportunity for weeding out the less dependable workers, and in part to the growing desire of all members of the force to retain their jobs,

Costs Decreased Without Change in Wage Scale

"Owing to inadequate or otherwise unsatisfactory cost systems maintained in connection with most of these undertakings, I found it impossible fully to check the statement by actual figures. Accordingly, I asked my own company to make out the cost of any one process in an operation continued over a period of several weeks. That which was selected was a piece of concrete work: the costs studied were those for the common labor employed on this work from January 7th to February 4th of the present year inclusive. During this period the wage scale remained unaltered; but the personnel of the labor force underwent frequent changes.

"A graph of the labor cost of the work during the period noted shows a sharp and almost undeviating decline from day to day. On February 4th these costs were exactly 50 per cent. less per unit than were those of January 7th. It is my belief that the experience of my company is by no means isolated; and that in almost any labor force there lies the opportunity of realizing economies ranging from 20 to 50 per cent. without interfering with the wage scale.

"This implies, of course, that there is now increased opportunity for selecting men according to their suit-

ability for a given task, and an increased eagerness on the part of the men to make good. But this is as it should be; and the whole country ought soon to feel the effect of it in general improvement at all points. It is a case of supplanting so called liquidation of labor by proper adaptation of labor as a means of keeping the cost of doing things within the bounds of utility.

"And in this connection it may well be urged that state of mind is often as potent a factor in ultimate labor costs as is the rate per hour. Any one experienced in handling workmen has recognized the difference in output between a cheerful, capable man, anxious to hold his place, and one who is a little disgruntled, and quite conscious that he can get another job the moment he drops the present one. Multiply either case by thousands of individual instances and I believe that there will be found, in shifts of mental attitude, the explanation of much of the variation which occurs in unit cost. And this, after all, is the element of labor which directly affects the profit of the employer."

British Correspondent Wants to Get in Touch with Canadian Architects and Contractors

Glasgow, April 14, 1919.

The Editor, Contract Record:

An article appeared in "The Architects' Journal," published in London, entitled, "A Central Quantity Survey," in which the writer commented favourably on the practice prevailing in this country of tendering for building contracts on a common schedule.

On approaching the editor of the Journal for the inspiration of his article, which evidently came from the other side, I was told that the source of his information was the Toronto "Contract Record."

As a quantity surveyor of long standing, with a strong inclination to break fresh ground overseas, I am interested in this manifestation of approval from Canada. Some years ago I passed through Toronto and made tentative but ineffective efforts to get a few of your contractors to look into our method of quantity surveying, but the interest shown was merely theoretical and decidedly lukewarm. Time may, however, have worked a change and the advent of a new national method of measurement for Scotland, after years of labor, in which I had the privilege of taking part, has made our modern practice stronger and better than ever.

I would like to get into touch with those on your side, architects, contractors or others, who wish to see a change in the haphazard and wasteful system now in vogue and have it replaced by a stable, reasoned and effective method of dealing with building work, which now more than ever is a matter of national interest.

Would you be good enough to give this letter your consideration and pass it on to your correspondents, who might not be unwilling to communicate with me on the subject?

I am,

Yours faithfully,

Arthur L. Currie, F.S.I., F.F.S.,
Building surveyor and measurer

[There are doubtless many of our readers who are interested in the quantity surveying methods of Great Britain and wish to obtain more definite information about this system. If any wish to get in touch with Mr. Currie, the Editor of the Contract Record will be glad to transmit the names to our correspondent for attention.—Ed.]

Car Repair Building for C.N.R. at Halifax

Reinforced Concrete Plant is First Unit of Coach Cleaning and Storage Yards at Ocean Terminals

By J. J. MacDonald

AS part of the programme of work laid down and carried on by the Canadian Government Railways in 1918 at the Halifax Ocean Terminals, Halifax, N. S., for the transference of the passenger traffic from the old North End Station to the new Terminal Site, a permanent reinforced concrete building has been erected to provide shop facilities and accommodate the plant and stores for the first unit of the coach cleaning and storage yards. The layout of this yard and the location of the building is shown on the general plan appended.

The coach cleaning and storage yard is equipped with steam and compressed air connections, car watering hydrants, car gasing hydrants, vacuum cleaning outlets and battery receptacles. As indicated on the

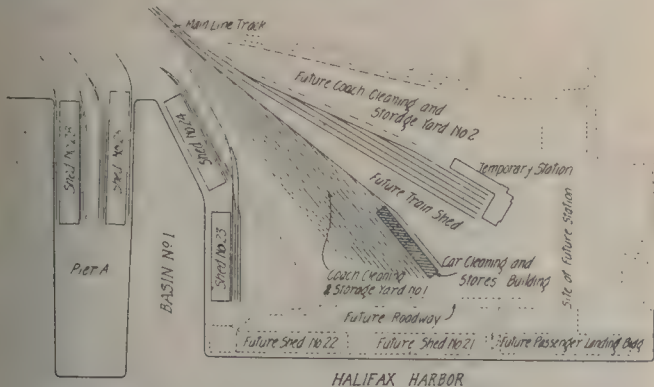
years ago. The harbor bottom here was rock covered by a few feet of mud. The foundations of the building, which were designed for a maximum unit pressure of $3\frac{3}{4}$ tons per square foot, were placed directly on the rock fill.

The shell of the building consists of a plain concrete base wall rising to the level of the window sills, a series of narrow wall piers between the windows and a reinforced concrete entablature and parapet wall above the window openings. The base wall is supported on its own footings. The wall columns of the main bents, which are spaced 20 ft. centre to centre, are of reinforced concrete and below the window sills are carried down with the reinforcement as pilasters of the base wall to enlarged sections of the footing. Midway between the column-bents are placed the intermediate wall piers.

In the single storey portion the wall columns support steel roof trusses extending the width of the building and carrying a 3-in. timber mill roof on steel channel purlins. Attention is called to the details of the connection between the wall columns and the steel trusses, which with the knee braces form a series of transverse portals.

Construction of Two-Storey Section

The two-storey portion of the building has a wall construction, similar to that described above, except that the long windows are divided by a spandrel section at the second floor. Two rows of inside columns are used under the second floor and the roof. The floor



General lay-out plan of Halifax Terminals project, showing location of car-cleaning and stores building

general plan, trucking platforms are provided between alternate tracks and along the east side of the building, which connect to the continuous end platform. The platforms are at approximately the same level as the floor of the building, to which ample connection is provided by a series of double doors.

Lay-Out of Building

The building is 380 ft. long by 51 ft. wide. Beginning at the south end a car cleaning shop occupies a length of 200 ft. This section is single story and is provided with car repair pits and accessories. The vacuum cleaning machine is also located in this shop. The remainder of the building is of two storey construction and contains the service or plant room, offices and stores rooms with the different car departments, ice storage room and refrigerators.

In the service room are installed an air compressor, Pintch gas compressor and a motor-generator set for car charging, switchboards, etc. The ice storage located near the north end occupies one bay for the full height of the building. Refrigerator compartments are placed in the extreme north bay of the building. The bay immediately north of the car cleaning shop is fitted up for locker rooms and lavatories.

The site of the building is made ground, composed of from 20 ft. to 35 ft. of rock fill, handled by steam shovel from railway cutting, and built out from the original shore line by side dumping cars about three

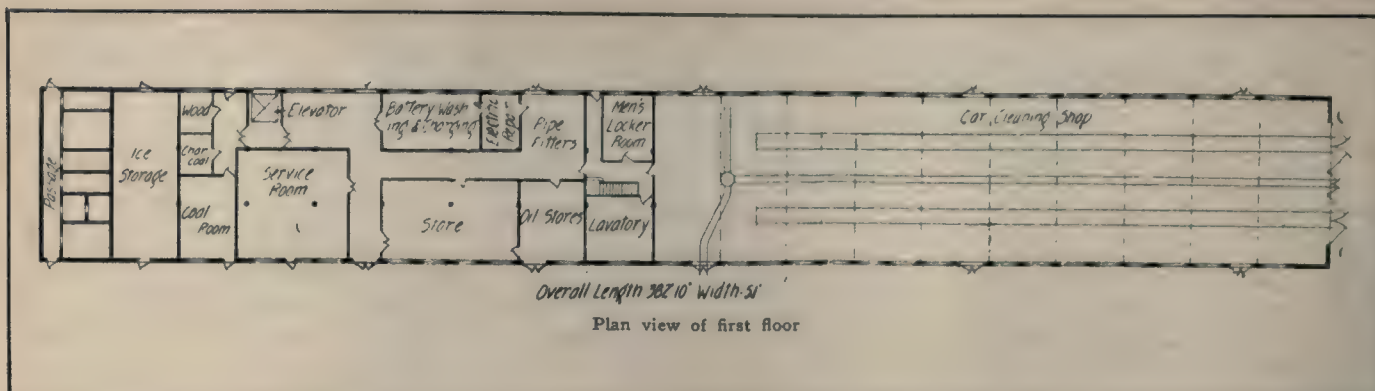


Reinforced concrete car cleaning and stores building for C. N. R., at Halifax

is of flat slab construction and the roof is of timber. A live load of 150 pounds per square ft. was assumed in designing the floor slab.

The type and details of the insulation for the ice storage and refrigerator compartments received a special study owing to the difficulty of obtaining cork and the usual insulating materials. Ten inches of well packed spruce shavings enclosed by two piles of $\frac{7}{8}$ -in.

*Assistant Engineer, Canadian National Railways, Moncton, N. B.



T. & G. spruce sheathing separated by two layers of heavy deodorized asphalt felt were used for the walls and ceilings. The floors of the refrigerator compartments were insulated by two $1\frac{1}{2}$ in. layers of cork placed in a concrete slab.

Considerable filling was required under the lower floor. Broken stone from the foundation pits was used in the car cleaning shop. In the remainder of the building three or four feet of sand filling were placed by dump wagons. The concrete floor slab was placed directly upon the filling after it was compacted.

The building was originally designed to be constructed, above the base wall, of precasts, but the contractor chose to pour the concrete in place. This necessitated the re-study of the problem of preventing cracking of the long entablature and parapet walls.

Provision for Settlement

The base wall was divided by keyed tar-paper joints located under the intermediate wall piers into sections 20 ft. long and poured in alternate lengths. The entablature and parapet walls were also divided by keyed joints into 20 ft. lengths. Alternate sections

ment was avoided and also the possibility of cracking, due to slightly uneven settlement of the foundations, was minimized.

Steel sashes were originally called for but owing to the high prices obtaining, wooden sashes have been



A construction view of car repair plant



Interior of car cleaning portion, showing car repair pits.

were poured integral with the columns, thus providing a series of longitudinal portals to give rigidity to the building. After the columns were poured the spandrel sections were placed with slip joints at the ends, and they were made separate from the floor system. By this layout the use of heavy temporary reinforce-

ment was avoided. The side sashes of the windows are made to open as hinged casements. All floors throughout the building are finished with Master Builders Hardner. Interior partitions were built of cement-sand brick which were manufactured at the site by the general contractors.

The building is heated throughout by low pressure steam radiators, steam being obtained from the main steam supply of the terminals. An adequate system of interior and exterior lights is provided. A $2\frac{1}{2}$ ton capacity electric baggage elevator is installed in the building. It is the intention to tool dress all the exposed concrete surfaces. For plain concrete a 1:3:5 mix with 2 in. stone was specified and for reinforced concrete a 1:2:4 mix with $\frac{3}{4}$ in. stone was called for. Five-ply tar and gravel roofing was used.

Construction Plant and Methods

Materials were shunted in cars directly to the site. A gasoline driven Jaeger mixer with hoist and placing plant was used. This machine was set up inside the building and discharged into a hopper at the second floor level. From this hopper concrete was wheeled to the forms. For the second storey portion staging was built at the level of the forms for the top sections of columns, entablature and parapet walls and concrete was wheeled up to this staging by long ramps.

For the single storey section the concrete columns were poured to the level of the bottom chords of the roof trusses and the bolts for the bearing plates and knee braces of the trusses were set in templates in the forms and concreted in. The steel trusses were then set in place with the wall bolts inserted in the end connection angles, with a sufficient number of purlins and bracing members bolted on to steady them. Plank staging was placed on top of the trusses along the forms on both sides of the building. From this staging the remaining lengths of the columns which received the wall bolts from the ends of the trusses, together with the entablature and parapet walls were then poured.

The concrete for the greater part of the entablature and parapet walls was placed in the early winter when the temperature ranged between 15 deg. and 20 deg. above zero. By using heated water, warm sand and aggregate, and tarpaulins at night over the new work, good results were obtained.

Ross & Macdonald, Architects, of Montreal and Halifax, prepared the general architectural plans and specifications for this building. The layouts of plant and construction details were made by the engineering staff of the railways. The Bate, McMahon Maritime Company, Limited, of which the late Colonel R. S. Low was manager, were the contractors for the work. C. R. Fancy was the contractor's superintendent on the ground. The writer had charge of the work for the railways under the direction of W. A. Duff, assistant chief engineer.

British Columbia Government Appoints Public Utilities Commissioner

MAJOR John L. Retallack has been appointed by the government of British Columbia to be Public Utilities Commissioner for the province under the new Public Utilities Act. Major Retallack is a returned soldier having gone overseas as quartermaster of the 48th Battalion. Later he was transport officer in the railway corps. He is a mining engineer and a member of the Canadian Mining Institute. The new commissioner was born in Quebec on December 2nd, 1863 and was educated in England. He served for five years with the Royal Northwest Mounted Police before coming to British Columbia in 1890. The appointment of Major Retallack came after several days of public clamor when the government's first appointment of R. H. Gale, mayor of Vancouver, met with such opposition from the returned soldiers' organization that Mr. Gale tendered his resignation. Several weeks ago it was reported that Mr. Gale was slated for the position. Returned soldiers' bodies immediately protested, pointing to the government's promise to give returned men preference for any positions. When the appointment of Mr. Gale was announced on April 17th, gatherings in Vancouver denounced the move in such terms that Mr. Gale went to Victoria to consult the cabinet. On his return on Saturday, April 19th, he announced that he had resigned. Mr. Gale had been active in opposition to the B. C. Electric Railway, the largest public utility in the province and on his resignation made this statement:

"To be perfectly frank, having had charge practically of the city's side of the case in the B. C. Electric dispute, I prefer to be in the position of arguing this side of the case before the commission rather than sit in judgment upon it. It is four years since I started

in to attempt to secure cheaper light and power, and it is only natural that I would like to present my arguments on the city's behalf as their advocate on what I have always believed to be the merits of the case as it exists to the first tribunal before whom it has been possible to have our case presented for consideration."

Immediately on Mr. Gale's resignation, the cabinet of the province recommended the appointment of Major Retallack and the lieutenant-general made the appointment forthwith. The commissionership carries with it a salary of \$7,000 a year.

Comparative Prices of Crushed Stone

THAT the Ontario prices of crushed stone compare very favorably with the corresponding prices throughout the United States and are in many cases lower is evident from the comparison tabulated below. The prices current in the United States are taken from "Macadam Service."

Crushed Stone Prices Per Ton at Quarry East of Pittsburgh

3-in. and larger	\$1.20 to \$1.35
2½-in. and less	1.20 to 1.75
1½-in. and less	1.20 to 2.00
¾-in. and less	1.20 to 2.50
½-in. and less	1.20 to 2.25
Screenings	.80 to 1.50

Middle West and Ohio

3-in. and larger	\$0.90 to \$1.70
2½-in. and less	.80 to 1.70
1½-in. and less	.80 to 1.95
¾-in. and less	.75 to 1.80
½-in. and less	.75 to 1.80
Screenings	.50 to 1.85

Mostly railway ballast and large orders.

West of Chicago

3-in. and larger	1.25 to \$1.40
2½-in. and less	1.25 to 1.40
1½-in. and less	1.25 to 1.50
¾-in. and less	1.25 to 1.50
½-in. and less	1.35 to 1.50
Screenings	.50 to 1.50

Southern

3-in. and larger	\$2.00
2½-in. and less	\$0.90 to 2.10
1½-in. and less	.90 to 2.50
¾-in. and less	1.20 to 2.30
½-in. and less	1.00 to 2.40
Screenings	.50 to 1.20

Ontario Prices

3-in. and larger	\$0.85 to \$0.90
2½-in. and less	.85 to .90
1½-in. and less	1.05 to 1.10
¾-in. and less	1.05 to 1.10
½-in. and less	1.05 to 1.10
Screenings	.50 to .70

Dr. Emile Nadeau, of Quebec, has been appointed Provincial Director of Housing by the Quebec Government. This is in connection with the Quebec Act for the construction of industrial houses, and every building scheme, including plans and specifications, will be subject to the approval of the Provincial Director of Housing. Dr. Nadeau has been a strong advocate of better housing.

With the object of protecting their trade interests, a Millwork Manufacturers' Association has been formed in Montreal. The constitution will be so framed as to allow the association to embrace every class of manufacturer doing mill work, and it will later on become a provincial organization.

Percentage Contracts Cannot be Condemned

Comparative Study of Unit-Cost Records Proves No Greater Inefficiency of Labor on Percentage Than on Lump-Sum Contracts

IN answer to the question: "Is it your experience that labor is less efficient in cost-plus construction and if less efficient, is the fact due to the form of contract or to some other cause?" Henry C. Turner, president of the Turner Construction Company, New York, writes the following article in Engineering News-Record, basing his facts on careful unit-cost records in all the contracts of the company during peace operations just prior to the war and on a large amount of war-time construction. Not only does the company see no labor inefficiency but, as stated in detail, it thinks that this form of contract has many advantages. Mr. Turner's article follows:

Labor Efficiency Good on Percentage Contract

During the year 1918 we were engaged almost entirely in government work, carried on under the standard percentage with a limiting fee form of contract. To obtain a comparison between our experience with percentage and lump-sum work, it is, therefore, necessary to go back to the year 1917. In that year we find that we built 22 factories and warehouses of reinforced concrete, on which our contract exceeded \$100,000 each, averaging \$413,000 each. Of these 22 buildings 13 averaging \$470,000 each in cost were built under a percentage form of contract and nine averaging \$329,000 each in cost were built under a lump-sum form of contract.

While some of these buildings were more elaborate than others, they were all of the factory and warehouse type and enough alike to make an average comparison of units between the percentage group and the lump-sum group possible. Some of the buildings considered were flat-slab and others beam-and-girder, and later in this analysis will be noted the influence of this fact on the units obtained. Attention will also be drawn to the effect which the height of a building has on the unit cost of floor forms, etc.

For purposes of comparison of cost, three labor units have been selected covering the three principal divisions of the work included in such construction.

Item 3-F. Cost of carpenter and labor work per square foot of floor required for placing and removing floor forms, including all hoisting and miscellaneous work in connection therewith. This item does not include the cost of making the forms before they are used for the first time and, therefore, a comparison is possible as between buildings having a different number of stories.

Item 22. Cost of labor per cubic yard for all labor in connection with the mixing and placing of concrete. An average of this unit will give a very fair comparison.

Item 30. Cost of all labor per ton for receiving handling, bending and placing steel reinforcement. As the labor conditions under which this work is done are different in the metropolitan districts from the conditions existing outside of these districts, one comparison is made between jobs located in the metropolitan districts and another comparison is made between the jobs outside of such districts.

There is also included in the table the amount of money spent for all labor disbursed under Item 19, "General Expense," expressed as a percentage of the total payroll for the job. This is done to show that the units obtained on the 3-F, 22 and 30 Items were not influenced by incorrect charging of labor to General Item 19, thereby reducing the amounts properly chargeable to the cost of forms and placing concrete and steel.

The results of the comparison are given in the accompanying tabulation:

Comparison Based on a Study of Cost Units on all Factories and Warehouses Costing Over \$100,000 Built by Turner Construction Co. in 1917
Total Number, 22

	Average unit on 13 percentage jobs.	Average unit on 9 lump sum jobs.	Percentage jobs were cheaper by	Lump sum jobs were cheaper by
Item 3-F. Cost per square foot of placing and removing floor forms	5.75c.	6.25c.	8%	
Item 22. Cost per cubic yard of mixing and placing concrete	\$1.02	\$1.04	2%	
Item 30. Cost per ton of receiving, bending, fabricating and placing steel reinforcement on jobs in the metropolitan districts	10 jobs \$15.71	4 jobs 14.89		5%
Item 30. Cost per ton of receiving, bending, fabricating and placing steel reinforcement on jobs outside of the metropolitan districts	3 jobs \$9.01	5 jobs \$8.87		2%
Item 19. General expense. The amount charged to this miscellaneous item is expressed as a percentage of the total payroll	1.8%	2.3%		

Effects of Various Items

The items will be taken up separately; comparisons are made under Item 30 for jobs located within the metropolitan districts and for jobs located outside of such districts.

Placing and Removing Floor Forms—There is some difference in the cost per square foot for the 3-F item as between flat-slab and beam-and-girder construction. By a coincidence it happens that 14 per cent. of the floor area in the percentage jobs was beam-and-girder and 86 per cent. was flat-slab, while in the lump-sum jobs 13 per cent. was beam-and-girder and 87 per cent. was flat-slab. Because of this similarity the comparison made between the average units on the percentage work and on the lump-sum work is not influenced by any difference due to the slightly greater cost of beam-and-girder forms over flat-slab forms. The column spacing was near enough the same in all of the buildings, so that any difference due to this element may be disregarded. The 3-F item has a tendency to be lower in buildings having a greater number of stories, because the 3-F unit for the first floor is nearly always higher than the 3-F unit for floors above the first. As all of the buildings studied are five stories, or over, in height, with the exception

of two, which are four stories, the influence of the element of height is very slight. It is to be noted that the next to the lowest 3-F unit obtained on any of the 22 buildings was at the Beckers Aniline & Chemical Building, which is only five stories high, and the units made on the two 4-story jobs are each below the average. It is believed that a comparison of the 3-F unit as between the percentage group of jobs and the lump-sum group is a fair comparison and means that if anything our organization on the percentage had the jump on the lump-sum job organization for this item.

Mixing and Placing Concrete—With equal efficiency on the two classes of construction the averages of Item 22 should run very close together, and such is the case, the difference being only 2 per cent. in favor of the percentage organizations.

Receiving, Bending, Fabricating and Placing Steel Reinforcement in Metropolitan Districts—The lump-sum jobs beat the percentage jobs by 5 per cent., and this difference is probably justified by the more difficult conditions affecting this Item 30 that existed on the percentage group of buildings.

Receiving, Bending, Fabricating and Placing Steel Reinforcement on Jobs Outside of Metropolitan Districts—The lump-sum jobs beat the percentage jobs by 2 per cent. The comparison is a fair one and should be a true indication of efficiency.

General Expense—The amount of money covered by the classification in Item 19 is very small compared with other items used in the table. The only reason for tabulating the item was to show by its smallness that improper charges had not been made to this general item, thereby reducing the charges of payroll made to Items 3-F, 22 and 30.

Low Cost Not Confined to One Type

If lowest units made on these 22 jobs are sought it is found that the lowest unit in placing and removing floor forms was made on the Belleville job, a percentage contract, and that the next lowest unit was made on the Beckers Aniline & Chemical Co. job, also a percentage contract. The lowest unit made in placing concrete was on the Bush Service Building, a percentage contract, and the next lowest was at the United Cigar Stores Building, which was also a percentage contract for the Bush Company. The third lowest was at the Belleville job, which was a percentage contract, and the next was at the Winchester Woollen Mills, a lump-sum contract. The lowest unit on placing steel reinforcement, outside of the metropolitan districts, was on Endicott-Johnson, a lump-sum job, and the next lowest was for Belleville, a percentage job. In the metropolitan districts the lowest for placing steel reinforcement was at the Beckers Aniline & Chemical Co. percentage job, the next best was at the Bush Service Building, also a percentage job.

It is believed that the figures justify the statement in reply to the first question that in a properly organized construction company there is no difference in efficiency in labor engaged on percentage work as compared with lump-sum work. So far as this company has ever been able to see, a good superintendent, or a good foreman, shows the same interest in his job whether it is on percentage or lump-sum. This will always be the case if he works for a company which rewards him just as quickly for good work on a percentage job as for good work on a lump-sum job and penalizes him just as severely on one class of work as on the other.

Answering the second question—there seems to be

no valid reason why labor should be less efficient on the percentage job than on the lump-sum job. A workingman is naturally primarily interested in his own welfare, and hence in the keeping of his job. If negligence and a lack of interest in his work lead to his discharge on the percentage job just as quickly as on the lump-sum work, while he finds that diligence on the percentage job is rewarded by advancement and continuous employment by the contractor, he will work just as hard on one form of contract as on the other.

There has been published recently a number of articles in which the position was maintained that percentage work has ruined the moral character of the American contractor and the American workingman. This company believes the opinions expressed in these articles are based either upon some unfortunate personal experience with the percentage form of contract, or are founded on observation made on the general run of percentage work during the war.

Many owners have had trouble over percentage contracts, just as many owners have had trouble over lump-sum contracts, but in nine cases out of ten the fault has been with the owner in not making sufficient investigation before he awarded his contract. There are plenty of good contractors to handle percentage work if the owner will only take the trouble to find them. Any owner intending to buy a piece of property will have a very careful search made of the title, and will have someone spend much time in investigation and study before he decides to purchase. Too often the owner will select a contractor because the contractor's selling agent sometimes knowingly, but much more often through lack of knowledge of construction work, will promise anything the owner wishes in the way of speed or price. Surely, the selection of a building contractor for the confidential position he occupies on percentage work is worthy of some study, but it is not infrequent for an owner to award a large percentage contract with less study and investigation than he would give to the purchase of a motor car.

Owner Should Study Both Systems

It is not difficult for the owner to get reasonable assurance that he is picking the right man for the job. In the first place, no contractor should be selected for percentage work unless he is very well known to the owner or has a very considerable record on such work. Let the owner ask the contractor for a list of all jobs he has built. Very likely several of these jobs were for persons known to the owner, in which case the investigation will be easy. If the entire list was for strangers, then let the owner pick about a dozen jobs similar to the project he has in mind and thoroughly investigate the contractor's record on all the jobs so selected, having his representative make personal calls, where possible, to obtain the information. The price to any owner for satisfactory work on a percentage basis is the comparatively slight trouble of thorough investigation before the contract is let.

It is a fact that a considerable prejudice against the percentage or fixed-fee form of contract has arisen because of observations made on such work during the war. Conditions in the building industry were in many cases deplorable during the war, but these conditions would have existed in most of these cases had the work been on the lump-sum basis. The majority of the large government operations were built far away from any labor market, which made it necessary to hire men in the large cities and send them to these out-of-the-

way places where they were housed in wooden barracks. In most cases the rates of wages established by the government, and made obligatory on percentage contracts in such out-of-the-way places, were lower than the wages paid in the large labor markets in which men were recruited. As more work was always available in the large cities than the supply of competent mechanics and good laborers living in such cities could handle, there was no incentive for a good man to leave his home. The result was that these out-of-the-way jobs had to be built with so-called floating labor; there was no other way to get the jobs done. This labor in many cases was not physically fit to do a day's work and, in order to get the work done at all, it was necessary for the superintendents and foremen to exercise the greatest of forbearance.

War-Cost Additions Due to Inexperience of Workmen

The experience of this company during the 1918 war period illustrates the condition that existed. It was then building for the government, at the same time, the naval base in Brooklyn, the army base in Brooklyn and the navy and war office buildings in Washington. During the war, on account of the shortage of labor, the government ordered a 10-hour day for laborers mixing and placing concrete, paying time and one-half for overtime. The labor rate in Brooklyn was \$3.25 to \$3.60 for eight hours, while in Washington it was \$3.20 for eight hours. The cost of mixing and placing concrete per cubic yard on the naval base was \$1.25, including a large amount of miscellaneous work, \$1.19 per cubic yard on the Army base and \$1.98 per cubic yard at the Navy and War buildings in Washington. The rate of wages per hour was lower in Washington than in Brooklyn, and the overtime affected jobs in both cities to an equal extent. The more difficult nature of the work in Washington would justify a difference of only about 20c. per cubic yard had the wage rates in the two cities been equal, hence an inspection of the unit costs on the three jobs shows the inefficiency of the workmen on the job in Washington as compared with the workmen in Brooklyn.

In Washington there was no home labor market and no quarters for housing men except temporary wood barracks. As a result, in order to keep the job supplied with the 1,400 laborers required, it was necessary to ship into Washington 4,000 of such men as could be gotten from New York, and in addition considerable numbers were obtained in other cities as far west as Chicago. It is to be remembered that it was very much easier to persuade fair workmen to go to Washington than to get such men to go to the small out-of-the-way places in which most of the government plants were located. Inefficiency and resulting high units were, therefore, to be expected in such places, and they would have existed on the work of any honest contractor in the same degree had his work been done on a lump-sum basis.

Comparing the results obtained on the naval base and on the army base in Brooklyn with the result the company was able to get in 1917, it is found that the cost of labor per hour of actual time worked was 18 per cent. higher in Brooklyn in 1918 than in 1917, due to an increase in the average rate from \$3.12 per eight hours in 1917 to \$3.35 per eight hours in 1918, and the effect of paying time and one-half for the two hours overtime each day in 1918. Hence the units of \$1.25 per cubic yard made on the naval base in 1918 and \$1.19 made on the army base in the same year are

equivalent to units of \$1.06 and of \$1.01, respectively, if made on the same jobs in 1917. This comparison shows that there was no serious loss of efficiency during the war in the labor of placing concrete in the Brooklyn district, due to the fact that Brooklyn is a good labor market, and, therefore, the gangs were composed largely of experienced concrete laborers, many of whom had worked for the company for years.

To state the effect of the war condition on construction work in another way—the experienced workman in most lines of the construction industry continued to give good service during the war when working for his old employer, but there were not enough of these experienced workmen to carry on the government building programme and it, therefore, became necessary to employ large numbers of men new to the industry. These men were frequently found inefficient. The effect of this dilution was felt to some extent in the large labor markets and to a considerable extent in places like Washington, but affected work in out-of-the-way places very seriously, because, the established government rates of wages on percentage jobs being lower there than in the large labor centres, it was almost impossible to get good men to leave their homes to go to such places.

There is no reason or justice in forming an opinion as to the relative advantages of percentage or lump-sum work based on war-time experience. Where such a comparison is made, the person making it is generally comparing in his mind the efficiency of the percentage job he saw during the war with the efficiency of lump-sum jobs he may have seen carried on before the war, or if he does have in his mind one of the comparatively few lump-sum jobs built during the war, he forgets that the contractor on such a job was not subject to the government wage scale and, therefore, by paying wages above that scale could get the pick of the men.

Two Types About Same During War

Comparing again the costs obtained on percentage and on lump-sum work, it is interesting to note that the average unit of \$1.47 for labor per cubic yard on concrete on the naval base, army base and navy and war office buildings was only 1c. higher per cubic yard than the \$1.46 unit made on the only large lump-sum job we built during 1918. On the three government jobs, the average cost of Item 3-F was 8.03c. as compared with 9.19c. on the lump-sum job. The cost of placing steel reinforcement on the government jobs in Brooklyn in 1918 averaged \$21.32 per ton, which is a considerable increase over the 1917 average for percentage and lump-sum jobs of \$15.26 obtained from the table. Approximately \$3.97 of this difference is due to a 26 per cent. increase in the average hourly rate of wages paid, caused by a 9 per cent. increase in the rate per eight hours and the effect of overtime. The balance of the difference between the 1917 and the 1918 unit, amounting to \$2.09 per ton, must be charged in part to the fact that on the government work economy had to be sacrificed to speed to a certain extent, and in part to a falling off in the efficiency of the workmen.

The cost of placing steel reinforcement on the job in Washington during the war was \$16.22 per ton. This is an abnormally high figure for such work outside of the metropolitan districts and was due to the inefficient men obtained in Washington. Almost the entire experienced steel gang left and went to work for another

contractor who had a lump-sum contract, because he paid wages above the scale fixed as a maximum by the government for percentage work in Washington. This statement is not to be taken as a criticism of the other contractor. He had taken his contract before the full effect of war conditions, was realized and had to get fairly efficient men or suffer a very severe loss.

The percentage and cost-plus-a-fixed-fee form of contract is of great advantage to the responsible contractor in helping him to secure work on an equitable

basis, and is of equally great advantage in many cases to the owner, enabling him to get work started on important projects months before detailed complete plans and specifications could be prepared for lump-sum bidding.

It is felt that the importance of the subject has justified a frank statement of the facts as this company has found them, because in our opinion any general condemnation of the percentage contract is unwarranted.

The Relation of Street Systems to Highways Outside of Urban District

THE need of suitable connections between the primary street systems of a city and the chief highways traversing the immediate surroundings of the city was pointed out by Mr. Nelson P. Lewis, Chief Engineer, Board of Estimate and Apportionment, New York city, in a paper presented at the recent convention of the American Road Builders' Association. An abstract of the paper follows:

The interest of the city, the county and the state is still largely confined to the system of streets or roads under the jurisdiction or control of these several units, and they have not been regarded as one great system of vital interest to all the people.

Rural highways connecting more or less important centres of population are generally much older than any part of city street systems except those in the oldest parts of the towns, while the outer and newer parts have been much more recently planned. It might have been assumed that the traffic between these centres of population would continue to follow these old routes, and yet how often it is found that they are reached only through streets of minor importance, often shabby and unattractive, not infrequently by means of awkward and obscure offsets, so that the dominant feeling is one of relief in leaving them or of extreme unpleasantness in entering them. The same experiences are likely to await the tourist in approaching or leaving the smaller town or satellite city.

Improvement to Approach of City

On the other hand, when a county or state road system is being improved, even when the roads selected for improvement lead directly to well established city streets of adequate width, and where the further expansion of the city is quite certain to follow along this trunk highway, an increase in the width of such road as it approaches the city, the improvement of its alignment and grades, special attention to its cross-section and drainage, the planting of trees and a little more care given to the road-side would be of incalculable benefit and involve little additional cost, while it might save much expense for future widening and much annoyance through traffic congestion. Of course, this requires vision, a quality all too rare, and it may even involve the diversion of traffic through by-passes about already existing centres.

The value of a trunk line highway is generally in proportion to its length, provided it is well improved throughout, and the value to the public of its improvements depends in no small degree upon the promptness with which the entire improvement is carried out, so

that it may be made available for modern traffic for its entire distance. There are cases where an important state highway has been improved for long distances on both sides of a town and up to its corporate limits, but the town is not disposed to undertake a similar improvement of the portion of the road within its limits. The state may have the right to, and in equity it should, bear a certain portion of the expense, this portion depending upon the width at which it is to be improved through the town as compared with the width of the part outside of the town, but there may be no way of compelling the town to do its part. The result may be a delay of years in the realization of the benefit which would result from the complete improvement of the road, the annoyance and expense of reducing speed or load to adapt them to the bad condition of the road within the town or a detour around it if one is available. Such a detour, where a road is under construction or repair, is accepted philosophically as it holds out a promise of better conditions in the near future, but when due to the deliberate unwillingness of the town to put its part of the road in as good condition as the adjoining rural sections it gives rise to some unkind thoughts and words as to the indifference and backwardness of the community which is responsible for the conditions.

The Town That Cannot Improve

And yet there is often much to be said in extenuation of the attitude of the town or small city which does not promptly undertake its share of the work. It may be a community where real estate values are low, where there are few if any, industries contributing to traffic which uses the road and few who would use it for pleasure, where there are no natural attractions to induce the tourist to stop, where there is not even an inn which one would be tempted to do other than avoid. The taxpayers of such a town think it unjust, and not unnaturally, that they should be called upon to provide a good road for what to them appears to be alien traffic, leaving nothing in its wake but a cloud of dust or a smell of gasoline. Such conditions present a serious problem in the development of a complete state or national improved road system.

It is probable that many of the state highway laws provide for a determination of the proportions of the expense of improving such a link in its road system which should be borne by the state and the town, such proportions depending upon the additional width or the more costly type of the road through the town, but there may be no means of securing prompt action by

the town authorities in providing its share of the funds. Such laws, where they exist, are necessarily uniform and inelastic; but even this is better than would be the practice of enacting special laws to fit each case. This would result in endless log rolling, unfair compromise and grave abuse. It is difficult, if not impossible, to standardize where conditions are quite different.

Improvement of Entire Trunk Highway

Prompt improvement of the entire trunk highways is the object to be sought. The state should be able to secure this result, but without injustice to communities where the imposition of the share of the cost determined by statute would involve serious hardship. It would seem as though the power to carry out such improvement at the time other sections of the road are improved should be vested in the state, which would become responsible for payment for the work in the first instance, and that the town should be obliged to contribute such share as may be designated by law, provided the law so specifies, with the right of appeal to some high judicial body which would have the power either to decrease or increase the proportion fixed by statute, the decision in each case to be reached after careful consideration of all the circumstances, including population, the assessed value of real estate in the town, its existing debt and tax budget in relation thereto, the amount of traffic originating in the town, the need of other improvements, the width of its streets in proportion to their traffic and probably other factors which would be essential to a fair determination of the issue.

This suggestion may be somewhat crude, but it is put forward in the belief that the conditions which it is designed to meet are a serious obstacle to the prompt realization of a complete scheme of state and national highway improvement, and also in the belief that the value of such a system is dependent in no small degree upon the promptness with which it can be wholly completed. It will probably be found that the cases where a town has obstinately and persistently refused to do its share of the improvement of a trunk highway passing through it are comparatively rare, and that they are quite generally ready to pay not only for the extra width but also for the improved type of surface deemed suitable.

Large Cities Should Also Contribute

Where a state contains a large city, the population of which is a very large proportion of that of the state, and the assessed value of the real estate in which, and consequently its contribution to the expenses of the state, is more than that of all the rest of the state, and where none of the state funds for road improvement are expended within the city limits there is likely to be a certain degree of resentment on the part of the city at what it deems an injustice, especially if the city receives no part of the receipts from automobile licenses or registration fees. While this feeling may be justified it must be remembered that a very large proportion of the vehicles using the state highways come from the cities, while few of those in the rural districts are tempted to go to the crowded city streets for pleasure riding or are compelled to do so for business reasons. This is conspicuously true as to the heavy motor vehicles which result in the greatest wear upon road surfaces, the great majority of which are engaged in delivering goods from the large cities, where they are manufactured, to outlying towns, and

which probably will soon be engaged in a vastly increased inter-city and inter-state traffic.

There has been too much of a disposition in the past to consider city, county and state highway systems as if they were three separate and distinct things, while we will not satisfactorily solve the problem confronting us until we think in larger terms and realize that they are only parts, under different jurisdictions, of a great national enterprise worthy of the best efforts and enthusiastic support of every one of us.

Amendments to Ontario Highway Act

A BILL to amend the Ontario Highways Act has been passed in the Legislature. One amendment is the striking out of the clause in sub-section 1 of section 16, which limited the amount to be contributed by the Province for work within suburban areas to \$4,000. Section 16 is further amended by adding the following clause:

"Any suburban road or portion thereof may be designated a 'Provincial County Road' in pursuance of section 28 of the Highway Improvement Act, and when so designated expenditure thereon for construction and for maintenance and repair shall be borne by the county, city or town, and the Province in the proportions of 20 per cent. by the county, 20 per cent. by the city or town, and 60 per cent. by the Province."

Another section has been added, providing that "the Minister of Public Works and Highways may arrange for special instruction or publicity in respect of highway improvement, and the cost of such service shall be payable out of any funds appropriated by the Legislature for special instruction of superintendents.

A section is also added prohibiting the dumping of earth, debris or excavated material from drains constructed, improved or repaired under the Municipal Drainage Act or the Ditches and Watercourses Act, within the travelled portion of any township road, or within the limits of any county or provincial road, except express permission in writing is received from the authorities responsible for the maintenance of the road.

Another added section provides that "The council of a local municipality may construct a sidewalk on a county road, provincial highway or a road or highway under the control of a board, special commission or other authority, but no such work shall be undertaken without the consent in writing being first obtained from the county council, department of public highways, board, special commission or other authority having control of the said road or highway."

The Administrative Council of the city of Montreal have requested the aldermen to express their desires in relation to the La Salle Bridge Act. This authorizes the commissioners to make a settlement with Messrs. A. Pion, F. A. Grothe and T. O'Sullivan, contractors, who threw up contracts for the construction of the bridge owing to war conditions. A settlement can, however, only be made on the recommendation of the Council. The city is authorized to return the contractors' deposits, as well as their equipment, pay for the value of the work done, and settle the claims of the contractors. Failing a mutual agreement between the parties within six months, the entire questions at issue must go to arbitration.

The 19th Annual Convention of the Union of Canadian Municipalities will be held in the city of Kingston, Ont., Aug. 12th, 13th and 14th, 1919.

Sixth Canadian Good Roads Congress and Exhibition, May 20-22

Parliament Buildings, Quebec City, Will be Location of This Year's Premier Canadian Good Roads Convention—Program is Given Below

TUESDAY, MAY 20th

Morning Session

Registration of delegates and visitors at Parliament Building. Registration continuing throughout the Congress.

Appointment of Nomination, Resolution and Legislation Committees.

Address of Welcome.

Afternoon Session

"Federal Aid," by Hon. J. D. Reid, Minister of Highways, Railways and Canals, Ottawa.

"Highway Maintenance," by Capt. J. A. Duchastel de Montronge, C.E., Manager City of Outremont, P.Q.

"Gravel Roads," by Chas. Talbot, C.E., County Road Superintendent, London, Ont.

"Surface and Subsoil Drainage and Foundations," by Gabriel Henry, C.E., Chief Engineer, Province of Quebec Highways Department.

Annual dinner and entertainment at Chateau Frontenac in the evening.

WEDNESDAY, MAY 21st

Morning Session

"Roads as an Aid to Agriculture." Address by Hon. Geo. S. Henry, Minister of Agriculture, Province of Ontario, and Hon. J. A. Caron, Minister of Agriculture of Quebec.

"Hot Mix Asphalt Pavements," by Francis P. Smith, Ph.D., Consulting Engineer, New York City.

"Practical Advice to Road Superintendents and Municipal Councils," by Alexandre Fraser, C.E., Assistant Chief Engineer, Province of Quebec, Highways Department.

"Bituminous Macadam." (Penetration Method) by A. W. Dean, Chief Engineer, Massachusetts Highway Commission.

Annual Meeting, Canadian Automobile Association, at Chateau Frontenac.

Afternoon Session

"Shall We Restrict the Load or Build the Road?" by W. A. McLean, Deputy Minister of Highways, Province of Ontario.

"Concrete in Road Construction, Culverts

and Bridges," by Eltinge G. Breed, Chief Engineer, New York State Highways Department, Albany, N.Y.

"Construction and Maintenance of Macadamized Gravel Roads," by Alex. Lariviere, C.E., Engineer, Province of Quebec, Highways Department.

"The Use of Refined Tar in Construction and Maintenance," by Paul D. Sargent, Chief Engineer, Maine Highways Commission, Augusta, Me.

Evening Session

Annual general meeting, Canadian Good Roads Association for election of directors and officers, and reception of annual report and financial and other reports.

THURSDAY, MAY 22nd

Morning Session

"Schools for Highway Engineering," by Prof. A. T. Laing, University of Toronto, Ontario.

"Drainage," by Jas. H. McDonald, Consulting Engineer, New Haven, Conn.

"Construction and Maintenance of Macadamized Municipal Roads," by A. Paradis, C.E., Engineer, Province of Quebec, Highways Department.

"Macadam Roads," by A. P. Sandles, Secretary, National Crushed Stone Association, Columbus, Ohio.

Luncheon and drive at noon.

Afternoon Session

"Keeping the Highways Open in Winter," by Hon. Frank Carrel, Quebec.

"Road Machinery," by Prof. A. H. Blanchard, Consulting Engineer, New York City.

"A Comparative Study of the Different Methods of Transportation of Road Materials," by E. W. Gauvreau, C.E., Engineer, Province of Quebec, Highways Department.

"Contracts, the Contractor and Labor vs. Government Construction of Trunk or Main Roads," by Col. W. D. Sohler, Chairman, Massachusetts Highway Commission, Boston, Mass.

British Government Establishes Transportation Department

THE British Government has for some time been planning to establish a separate government department to deal with all matters of transportation, and a bill for that purpose is now pending in Parliament. The new department is to be called the Ministry of Ways and Communications and is to take over the powers of supervision over railways and other transportation utilities, which have long been exercised by the Board of Trade. So long as the railways continue under direct government management, as has been the case since Great Britain entered the war, this authority also is vested in the Minister of Ways and Communications. Besides the railways, the minister receives authority over the street railways, canals and other inland waterways, docks, piers, roads, bridges, ferries and the supply of electricity. The bill empowers the minister to fix all rates and charges and the wages of labor on all utilities under his charge. While there has been no official decision as to whether the government will take over permanently the railway lines of the country, the bill in Parliament gives the minister authority to purchase any utility under his charge outright at a price fixed by agreement or by condemnation proceedings.

Abstract of Provisions

The following is an abstract of the provisions of this most important Bill:

1. A Minister of Ways and Communications may be appointed for improving the means of, and the facilities for, locomotion and transport.

2. The Minister is to take steps to carry out this purpose, and all the powers and duties of any government department in relation to the following matters are to be transferred to him from dates to be fixed by Orders in Council:

- (a) Railways;
- (b) Light railways;
- (c) Tramways;
- (d) Canals, waterways, and inland navigations;
- (e) Roads, bridges and ferries, and vehicles and traffic thereon;
- (f) Harbors, docks and piers;
- (g) The supply of electricity;

including any powers and duties in relation to any railway, light railway, tramway, canal, inland navigation, harbor, dock, pier, electricity, or other undertaking concerned with any of the above matters.

Any powers or duties of the Admiralty exercisable in or in relation to ports declared to be dockyard ports under the Dockyard Ports Regulation Act, 1865, are not transferred to the Minister, and any powers of the Board of Trade with respect to dockyard ports may be transferred by Order in Council to the Admiralty.

3. (1) In order to afford time for the formulation of future policy the following provisions are to have effect for two years from the passing of the Act:

(a) Where possession has been taken of any railroad undertaking, possession may be retained upon the same terms as to payment as those already in force and the Minister may exercise over them the powers exercised by the Board of Trade and such other

powers as are conferred by this section or are agreed to by the railway companies concerned;

(b) The Minister may take possession of the whole or any part of any other railway undertaking, or of any light railway, tramway, canal, inland navigation, harbor, dock or pier undertaking, or of any plant belonging to them or used upon them and of any private railway wagons required for use on any such railway, and of any barges, tugs, and other craft required for use on any such canal.

(c) The directors, officers and servants of any undertaking of which, or of the plant whereof, possession is retained or taken are to obey the directions of the Minister as to the user thereof, and any directions—

- (i) as to rates, fares, tolls, dues and charges;
- (ii.) as to salaries, wages, remuneration and conditions of employment of any persons employed on or in connection with any such undertaking;
- (iii.) as to working or discontinuing the undertaking or any part including keeping open or closing any stations;
- (iv.) for securing that the permanent way, rolling stock, etc. are satisfactory in type and design;
- (v.) as to the carrying out of alterations, improvements and additions which the Minister considers necessary to public safety or for more efficient and economic working;
- (vi.) for securing co-operation between undertakings and for securing the common user of facilities, rolling stock and equipment;
- (vii.) for affording running powers to the owners of any other undertaking;
- (viii.) for securing that manufacturing and repairing facilities and auxiliary and ancillary services shall be used, and the purchase and distribution of stores shall be conducted, in a manner most conducive to economy and efficiency;
- (ix.) as to preparing and submitting to the Minister statistics, returns, and accounts.

(d) The Minister may order the owners of any undertaking to acquire any land and to construct any works;

(e) Any rates, fares, tolls, dues and charges directed by the Minister are to be deemed reasonable and may be charged notwithstanding any statutory limit.

(2) Any officer or servant of any such undertaking if required is to be transferred to the Minister, if permanently with the consent of such officer or servant, and if temporarily with the consent of the undertakers, but his rights as to any pension or superannuation scheme are preserved.

(3) For two years after the passing of the Act no new route for omnibuses may be established without the consent of the highway authority. "Omnibuses" include any carriage plying for hire and used to carry passengers at separate fares.

(4) Where by the exercise of the powers under this section the value of any undertaking has been depreciated or enhanced, the owners are to be entitled to be recouped the loss or are liable to pay gain, and any question is to be determined by the Railway and Canal Commission, which may call in assessors or hold or order a local inquiry if necessary. The Commission may act by two members, one of whom is to be the judge and is to have an unlimited discretion as to costs.

4. This clause gave power to the Minister by Order in Council to acquire and work any of the undertak-

ings mentioned above at any time after the passing of the Act and "undertaking" was to include any shipping or other services, carried on as ancillary, and such acquisition was not to be limited to the two years. It was announced, however, in the House of Commons on March 17th last, that the Bill would be amended by eliminating the procedure by Order in Council, the result of which will be that any such acquisition must be by a substantive Bill.

It appears to be intended to retain at any rate the following provisions of clause 4:

- (1) (e) Power to purchase, hire and lease railway wagons belonging to private owners;
- (f) Power to establish, maintain and work transport services by land or water limited to two years and to construct such works as may be necessary also limited to two years. Also powers are to be taken to prohibit the use of private wagons in future, except under license.

May Provide Funds

5. (1) The Minister may, subject to the approval of the Treasury, advance money for the construction, improvement or maintenance—

- (a) of railways, light railways, and tramways;
- (b) of roads, bridges and ferries;
- (c) of harbor, docks and piers;
- (d) of canals or inland navigations; and
- (e) for the promotion and improvement of transport services by land or water.

(2) The Minister may classify roads for the above purposes.

6. The owners of any railway, light railway, tramway, canal, inland navigation, dock, harbor, pier or electricity undertaking, and the authority or person liable to maintain any road or bridge must furnish the Minister with any accounts, statistics and returns which he may require.

7. The Minister may hold any inquiries which he thinks necessary or desirable, and any witness summoned to attend and failing to do so without reasonable excuse is liable to a fine not exceeding £5.

8. The Minister may appoint secretaries and staff. He is to be paid £5,000 a year and any parliamentary secretaries £1,500 a year.

9. This clause deals with the title of the Minister, how his orders are to be evidenced, prevents a member holding certain offices from vacating his seat when appointed Minister, and deals with the oath to be taken by the Minister.

10. This clause renders the Minister and two secretaries eligible to the House of Commons and prevents the first person appointed Minister from vacating his seat.

11. (1) The title is the Ministry of Ways and Communications Act, 1919.

(2) "Government Department" includes the Light Railway Commissioners, the Road Board, and the Lord Lieutenant and Privy Council of Ireland.

The building and supply men of Guelph, Ont., who, as previously announced, are forming a branch of the Provincial Builders' and Supply Association, have got their organization going. In our issue of April 23rd, we gave a report of their first meeting at which this action was decided upon. Another meeting has since been held and the following officers elected: President, Geo. A. Scroggie; vice-president, A. R. Reynolds; secretary-treasurer, W. A. Cowan.

Nearly Five Times Design Load on Concrete Floor Without Causing Collapse

LOADS from four to six times those for which the floor was designed have just been put on a reinforced-concrete building in Long Island City, N. Y., through the almost criminal negligence of a warehousing superintendent. The floor has cracked badly—so badly that the superintendent of Buildings of Queens Borough has ordered the load mostly removed and the floors shored up, and has required that they be repaired. There was no definite collapse, however, nor is there any evidence of any adverse effect on the rest of the building, a remarkable testimonial to the effectiveness of this type of construction. Engineering News-Record describes the situation as follows:

The building in question is known as the Kindel Bed Co. building. It is located in Long Island City in one of the boroughs of New York City. It is a four-story structure, and the section in question is 80 ft. wide and 218 ft. long. Transversely it is divided into three bays, the outer bays being 26 ft. 4 in. in span and the middle bay 27 ft. 4 in. In the other direction, columns are spaced 18 ft. c. to c. The floor is a girder, beam-and-slab type, 14 x 26-in. girders running lengthwise of the building and 8 x 22-in. beams being spaced 6 ft. c. to c. and spanning between the columns or the girders. The building was erected in 1916 and was designed for manufacturing purposes to have a load on this floor of 200 lb. per square foot.

The original owners of the building had vacated it, and the second floor, through a series of leases, came into the control of a warehouseman in New York city. Some time early this year he began storing, on the floor, boxes of sheet tin being held for the Standard Oil Co. preliminary to shipment to the far East. These boxes are of various sizes, but the main ones are 14 x 8¾ in. in plan and about 4 in. deep, and carry sheet tin to such an amount that the gross load of the tin plus the box is 122 lb. This gives a loading of about 68 lb. per square foot. Apparently the entire floor, except a 4-ft. aisle down the inside of the column rows, was loaded with these boxes, some of which were piled as high as 20 deep. It is the opinion of observers that in some places the load reached 1,300 lb. per square foot and that the uniform load must have been equivalent to a load of 900 lb. per square foot over the entire floor, about 4½ times the design load.

The first warning of trouble is reported to have been given by the night watchman, who heard ominous rumblings and crunchings which so disturbed him as to make him get outside of the building and stay out all night. The next day he reported the trouble, and it was found that many cracks were appearing in the floors. There was also a certain deflection, although this was not very considerable nor has it been measured. At any rate, Superintendent of Buildings Moore, immediately upon being informed of the trouble, put an "unsafe" order on the building and had a court require the survey demanded by New York law for such contingencies. Under the authority of this court order he removed enough of the load so that at present the floor is carrying somewhat over its designed amount. At the same time he strutted up those sections of the floor where the cracking appeared to be most dangerous. At present it is the intention to repair the floor or

to replace it, although the exact method to be carried out has not been determined.

The cracks in the floor seem to indicate that a continuous beam action was carried clear across the three panels of the 80-ft. width. Cracks appear in the floor-slab of the interior panel about the point of inflection,

and in some places are carried down a short distance into traverse beams.

Similar cracks around some of the columns appear in the longitudinal stringers, and in all cases the cracking seems to have been roughly circular around the heads of the columns.

Activated Sludge Experiments at Sheffield—Successful Results by Agitation

By John Haworth, F.I.C., F.C.S.*

IN July, 1916, a paper was read before the Association of Managers of Sewage Disposal Works describing some experiments carried out at the Sheffield sewage works, in which crude sewage was being treated by means of activated sludge without the use of compressed air. These experiments have been continued and developed, and two tanks on a working scale have been constructed recently, which are treating 50,000 to 60,000 gallons of trade sewage per day.

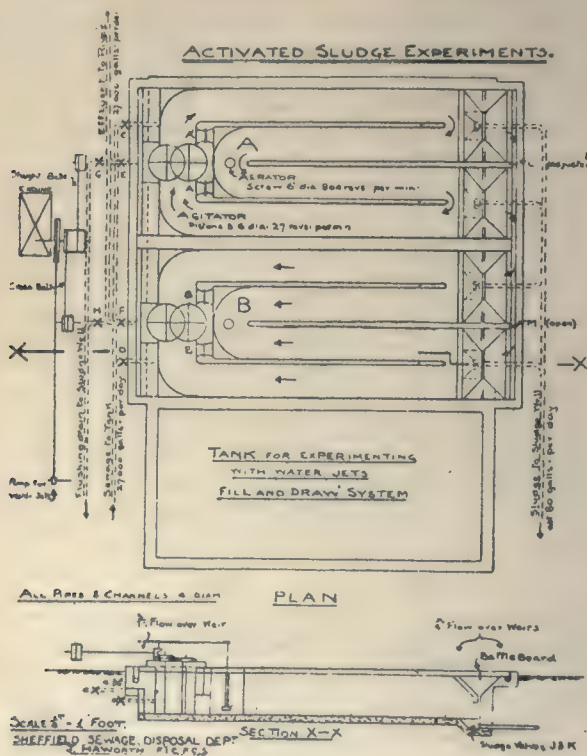
lating the revolutions of the paddle, purification could be obtained satisfactorily to the extent of at least three fillings of the tank per day, without the use of the aerator. The tank has been operated during the last two years in this manner. The table below indicates the character of the results obtained:

Surface Aeration With Suitable Agitation

The results of this and other experiments led to the conclusion that given suitable agitation, to obtain thorough intermixing of the activated sludge with the sewage, and to prevent settlement, the necessary air required to maintain the biological activity might be obtained by surface aeration. To accomplish this it was found necessary to produce constant change of surface of the liquid.

The question also suggested itself, and is worthy of investigation, whether in the case of systems where air is blown through the sewage, the aeration is not largely brought about by solution at the surface, by reason of the large disturbance and change of surface exposed by the rising bubbles, rather than by solution of oxygen from the bubbles themselves. It was evident that, except in the case of small tanks, the horizontal paddle type of agitator would not be quite suitable, and two tanks of a different type have recently been designed and put into operation—see sketch.

The tanks are 30 ft. by 14 ft. by 4 ft. deep, with level floors. Division walls have been constructed to form a continuous channel, approximately 3 ft. 3 in. wide, along which the sewage can circulate and return to an agitator placed at one end of the tank. The agitator consists of two vertical pistons of the Root's blower type. On rotating the agitators, the sewage is circulated at a velocity sufficient to prevent settlement of the sludge. A velocity of 1½ ft. to 2 ft. per second has been found ample to accomplish this result. A mechanical aerator was fixed in one of the tanks, in case additional air was required, but it has been found unnecessary. By means of the agitators and the special construction of the tanks constant change of surface occurs. One tank was put into regular use in October last. Humus, washed from material taken from a con-



Early in 1916 a tank of 800 gallons capacity was fitted with a paddle stirrer, and with an apparatus for inducing air mechanically. After this tank had been in use for some time it was found that by suitably regu-

*Chemist and Manager, Sheffield Corporation Sewage Works

Analysis of Samples from Experimental Aeration Plant, Sheffield Sewage Works, from November 27th, 1918, to January 31st, 1919.—Number of Samples, 45.—Results in parts per 100,000.

	Sewage			Effluent		
	Best	Worst	Average	Best	Worst	Average
Suspended solids	11.6	69.8	34.20	—	—	—
Oxygen absorbed in four hours	3.32	13.38	7.10	.15	.60	.32
Free and saline ammonia	1.224	6.41	3.34	.039	2.275	.424
Albuminoid ammonia	.304	1.74	.751	.022	.129	.05
Chlorine	6.7	16.8	9.8	6.4	16.0	9.29
Nitric nitrogen	—	—	—	1.55	.16	.75
Dissolved oxygen taken in five days at 65 deg. Fah.	—	—	—	.013	.389	.153

tact bed, was put in to a depth of about 6in., and the tank filled with sewage.

Industrial Sewage Experimented Upon

After ten days' agitation the sludge was completely coagulated and flocculent, and found to be sufficiently activated to allow the experiment to proceed. The tank was then worked on the fill-and-draw principle, and has purified sewage satisfactorily and continuously during the last three months, three fillings of the tank per day being dealt with. The liquid treated is an industrial sewage, containing at times a large proportion of iron liquors, soaps, etc. These at times have required extended periods of treatment.

The following table indicates the character of the sewage dealt with and the results obtained:

Analysis of Samples from Experimental Aeration Plant, Tinsley Sewage Works, Tank No. 1, from November 29th, 1918, to January 31st, 1919.—Number of Samples, 62.—Results in parts per 100,000.

	Sewage			Effluent		
	Best	Worst	Average	Best	Worst	Average
Suspended solids.....	9.8	119.6	44.7	—	—	—
Oxygen absorbed in four hours.....	1.88	17.26	5.84	.28	1.45*	.76
Free and saline ammonia.....	1.208	5.632	2.525	.110	3.024	1.249
Albuminoid ammonia.....	.364	3.560	1.131	.062	.277	.13
Chlorine.....	4.1	14.7	8.5	5.8	12.1	8.6
Nitric nitrogen.....	—	—	—	1.15	.03	.325
Dissolved oxygen taken in five days at 65 deg. Fah.	—	—	—	.017	.912	.277

*Agitators stopped for two periods

The power absorbed by the process described is calculated at 20 horsepower per million gallons, but there appears no doubt that the agitators employed could operate a much larger tank with only a slight additional power consumption. There is no doubt that a variety of types of agitator might be devised to operate such a process, probably with greater efficiency. Several types are at present under consideration. The Sewage Disposal Committee of the Corporation have already authorized the extension of the experiments to deal with the whole of the flow of their Tinsley works as soon as suitable plant can be obtained.

Concrete Institute Convention

THE provisional programme of the Annual Convention of the American Concrete Institute has just been determined upon. This year the Directors have called the meeting to be held at Atlantic City on June 27-28, where through co-operation of the officers of the American Society for Testing Materials, meeting there at the same time, one evening's joint session is possible. The other meetings of the Institute have been arranged so as not to conflict with the meetings of the other society, and an open afternoon has been left on Friday so as to permit the members of the American Concrete Institute to attend the session of the American Society for Testing Materials at which will be discussed the subject of cement, a matter of greatest interest to members of this society.

FRIDAY, JUNE 27th

Morning Session

Report of Committee on Plain and Reinforced-Concrete Sewers: W. W. Horner, Chairman.

Report of Committee on Treatment of Concrete Surfaces: J. C. Pearson, Chairman.

Effect of Vibration During Placing on Strength of Concrete: D. A. Abrams.

Investigation into the Economic Possibilities of Light

Weight Aggregate in Building Construction: A. W. Stephens.

Result of Investigation on Shear, Impact and Bond made for Concrete Ship Studies: W. A. Slater.

Afternoon Session

Papers on Cement at Meeting of American Society for Testing Materials.

Evening Session

Joint Session with American Society for Testing Materials.

Report of A.S.T.M. Committee C-1: On Cement: R. S. Greenman, Chairman.

Report of A.S.T.M. Committee C-9: On Concrete and Concrete Aggregates: Sanford E. Thompson, Chairman.

Report of A.C.I. Committee on Fireproofing: W. A. Hull, Chairman.

A.C.I. Paper: Later Fire Tests of Concrete Columns: W. A. Hull.

A.C.I. Paper: The Strainagraph and Its Application to Concrete Ships: F. R. MacMillan.

A.S.T.M. Paper: Effect of Fineness of Cement: D. A. Abrams.

A.S.T.M. Paper: Cement Producing Quick Hardening Concretes: P. H. Bates.

SATURDAY, JUNE 28th

Morning Session

Report of Committee on Reinforced-Concrete and Building Laws: E. J. Moore, Chairman.

Report of Sub-committee on Regulation for Strength Test of Floors.

Temperature Cracks in Chimneys: J. G. Mingle.

Plasticity and Temperature Deformation in Concrete: S. C. Hollister.

Report of Committee on Reinforced-Concrete Highway Bridges and Culverts: A. B. Cohen, Chairman.

Concrete Work on the Brooklyn Army Base: A. C. Tozzer.

Afternoon Session

Report of Committee on Concrete Roads and Pavements: H. E. Breed, Chairman.

Papers on Fuel Oil Tanks:

Design: H. B. Andrews.

Construction: H. E. Walton.

Tests: J. C. Pearson.

Report of Committee on Concrete Sidewalks and Floors: J. E. Freeman, Chairman.

Evening Session

Construction of Concrete Barges for New York State Canals: S. C. Hollister.

Layout and Equipment of the Government Concrete Shipyards: A. L. Bush.

Problems in the Design of Concrete Ships: J. Glaettli, Jr.

Problems in the Construction of Concrete Ships: R. J. Wig.

General Aspects of Grade Separation

An Important Phase of City Planning—Interests that Must Be Considered—Cost of Elevating Railroad Often Less Than Changing Streets

TRACK elevation in American cities has been a very live subject for some years. Scarcely a large city has failed to do some work in the separation of highway and railroad grades and to-day many cities of moderate size, with the example which has been set them by their larger neighbors, have at least awakened to the benefits to be derived, and to the importance of planning for the future in such a way as to best promote the city's welfare. Each city has its own peculiar problems, depending upon industrial conditions, topography, city layout, and the number and importance of the railroads within its limits.

The Division of Grade Separation and Bridges, of the city of Detroit, has recently issued a report which is partly a progress report and partly a study of the general and special problems with which the city is confronted as it looks forward to an extensive programme of construction. Many of these general problems and aspects of grade separation are necessarily common to other cities, and in the belief that the statement of these may be of interest to engineers engaged in similar preliminary work in other cities, this abstract of the report by Engineering and Contracting is herewith given.

Grade Separation and City Planning

Grade separation may be considered an important phase of city planning, because in its broadest sense city planning, deals with all the activities of life in a great city. The closing of some streets, the opening of some and widening and the straightening of others are sometimes needed as a part of the solution of the grade crossing problem. The establishment of a plan of main avenues of traffic is not only necessary for the convenience of the present population, but it gives better control over the plotting of land and the laying out of streets. The general rule seems to have been that American railroads were built with but little thought of the possible dangers and interruptions to traffic due to grade crossings. As traffic density increased upon the railroads, and second, third and fourth tracks were added, certain crossings became points of danger and were eliminated. As villages grew into cities and expanded territorially, the need of maintaining a few streets open to traffic at all times, caused both city and railroad officials to seek for some means of grade operation and a considerable amount of the work of elimination has been done in many cities, but in only a few has there been adopted any general comprehensive plan for the complete elimination of all grade crossings. It would appear from a study of existing structures and records that generally the work has been undertaken rather with a view to eliminating crossings because they were a source of danger to human life, or to secure a greater freedom of railroad operation from interruption by traffic on the highway, than as an essential part of a comprehensive plan for bettering city traffic conditions.

Every rapidly growing city faces conditions which

tend to increase the difficulty of handling its local transportation.

The need for more street cars, more rapid movement of cars, relief of congestion in the downtown section, and additional lines, as well as the possibility of establishing some form of rapid transit, are all matters of public discussion.

The development of the automobile in the past few years and the tremendous increase in the use of motor driven vehicles has introduced a new element in street traffic. Streets which a few years ago had only a few team movements of automobiles and teams per day. The increase in number of street movements makes more urgent the abolition of grade crossings, especially when we consider that on many streets there has been a corresponding increase in pedestrian movements.

Interests of Public and Railways in Grade Separation

No final adoption of any plan can be made until it has been considered from every possible angle. The interests of the city as a whole, and of the railroad, are or should be, so closely interwoven as to be a mutual interest and both parties should bend every energy to the immediate working out of a complete plan and its rapid execution.

It is undoubtedly the fact that in many cases the feeling has prevailed that the railroad and the city were opposing parties, and it is also the fact that in many instances the railroad interest had been looked upon as the paramount interest, and grade separation projects carried out which should not have been built simply because of the desire on the part of railroad management to avoid large expenditures of railroad money or change of existing condition of tracks and yards.

There are cases of surrendering public rights in the interest of present economy without regard to future traffic congestion. This would seem to be due rather to a failure to recognize the extent and character of the use of the city's streets than to a deliberate attempt to destroy values. It is equally true that the city is greatly benefited by the improvement of railroad facilities and the correct location of freight houses, team, tracks, switching and storage yards and industrial connections.

Both city and railroad would be benefited by the complete separation not of a few, but of all the streets. The actual carrying out of such separation is complicated by the fact that many hundreds of industries have located along the railroads, have built warehouses or factories and have sidings or industrial connections. Any plan that is adopted must take into account the three interests, and there must needs be occasional concessions to one interest or the other.

Interests that Must be Considered in Grade Separation Plan

The public demands an open and safe thoroughfare with sufficient clear head room to permit any usual street or street railway vehicle to pass freely. It must consider the future and not limit, by present day con-

struction, the reasonable future use of the street. The public may very properly protest against going up or down a heavy grade or against narrowing any roadway or against closing any roadway which may in a few years be essential to guard against a congestion. The public has a right to demand not only a safe, but a clean, reasonably noiseless, and slightly structure. In view of the fact that the public uses the crossing on important streets tens or hundreds of times to the railroads' once, the public interest may be considered the paramount interest, especially if we remember that the railroad is a public transportation utility and that the only reason for the existence of most of the tracks in a city is the convenience of that same public which uses the streets.

The railroad demands good roads—safe head room; the opportunity to run its through trains at high speed, the right to maintain for the benefit of its patrons all such facilities as stations and team tracks; the right to have ample yard facilities for switching, sorting and storing cars, and to have these yards so located that they will meet the requirements of different parts of the city, and further the right to maintain all necessary track connections to industries.

Industries Have Rights

The owners of industries must have such connections as will permit the receiving and shipping of freight. They must also have full use of the streets, and freedom from interruption to the movement of teams and employes to and from the industry. The fact that hundreds of industries are now in existence, on tracks at the surface level, that they have built and adjusted their business to those tracks, greatly complicates matters, as a change in level of track, or street or both, is bound in most cases to cause a readjustment or a reconstruction to fit the new conditions.

While all necessary side and spur track facilities should be afforded industries, the railroads and the city should co-operate in preventing unnecessary duplication of such service.

In most cases the existing arrangement at the manufacturing plant can be used without material change, in some cases a readjustment can be had by elevating the industrial spur and loading platform or by an interior rearrangement, and in still others, more especially very small industries, the cost of the construction to meet any condition that can be considered is such as perhaps to compel a removal of the business to some other location. All of these interests have been considered in the plans so far completed.

The sooner grades are finally agreed upon for every mile of track in the city, the sooner new improvements and extensions to existing industries can be designed to conform to the plan of separation, thereby saving hundreds of thousands or millions of dollars of reconstruction when the actual work of separation of grades is executed.

Grade Separation Plan Should Consider Future Needs

In making any plan for a public improvement in a city which has grown rapidly, it is essential that consideration be given to future demands. In this case it may be argued that the streets and railroads being now located the conditions of to-day fix the problem. This is not true. It is clear that all manufacturing plants of any magnitude, which locate in the city in the future, must seek a location well out from the centre of the city in order to secure room. The coun-

try road of to-day, with a traffic of 200 to 300 movements per day over a railroad crossing, may next year be paved with a street railway extension to a new plant, and traffic increased to between 1,000 and 2,000 movements per day. The new industry means new business for the railroad and, in most cases, many additional switching movements per day are made over the crossing, thus increasing the roadbed use.

There are three general methods of separating grades of street and railroad which have been adopted.

1. The railroad track is left as it is and the street is either depressed under the track or elevated full height over the track.

2. The street is left as it is and the railroad depressed or elevated to the extent required.

3. Both railroad and street are changed, and such compromises in grade made as best suit the requirements of the particular case.

Grade Separation by Depression or Elevation of Street

The advantages and disadvantages of the first method may be summarized as follows:

The advantages, all with the railroad, are (a) undisturbed main track, (b) no change of grades, (c) no changes of yards or industrial connections.

The disadvantages to the city are (a) enormous property damages, often extending several hundred feet from the railroad and on to side streets which may be involved; (b) serious interference in street depression with the sewers, drains, water pipes and other underground construction; (c) impediment to traffic, due to heavy grades of the streets and the additional rise and fall introduced; (d) injurious effect on the appearance of the street; (e) industries located on the railroad must provide new outlet, as, if the grade change involves the full width of the street, they are cut from access to the street.

The city of Chicago in first treating the grade separation problem spent several millions of dollars on long and costly viaducts over railroad yards. Finally it was seen that this was futile and a comprehensive plan of track elevation was adopted and is being carried out. This has involved pulling down many of the costly viaducts already constructed. The Chicago Terminal Commission of 1892 says:

"The topography of the city of Chicago is such that the streets and highways in their natural condition are practically level and in the exercise of the powers conferred and the duties imposed upon the Common Council, they should be preserved in the same condition to public use, unless there are controlling reasons to the contrary."

In 1908 the city of Toronto petitioned the Canadian Railroad Commission for the elimination of grade crossings along the water front. The railroads in question proposed that the grades be separated by carrying the streets over the tracks by means of viaducts without changing the grades of the tracks. Chief Commissioner Mabey in his opinion, Dec. 30, 1908, says:

"I am free to confess that when I embarked on this inquiry I thought the erection of bridges the proper solution of the problem, but the more it is thought out, keeping steadily in view the permanent welfare of a large and rapidly growing city, I am driven to the belief that, if bridges are erected this year, 10 years hence would see them all torn down."

Changing the Railroad for Separating Grades

From the standpoint of the hundreds of thousands of citizens who pass back and forth every day on the

streets in the course of their business, who are interested in the trucking and hauling of goods from point to point in the city, and who may not come into direct contact with the railroads at all in the course of a year's business, the ideal method is to leave the streets on their present level and move the railroad. The advantages of this method are:

(a) That it leaves the street on the best possible grade.

(b) That it practically or wholly eliminates property damages.

(c) That it creates no interference (in track elevation) with sewers, water mains, conduits or other underground construction.

The disadvantages to the railroad are: (a) introduction of additional grade and rise and fall of 20 to 25 ft. at one or both ends of the district; (b) more or less serious interference with industrial connections, in case of small industries sometimes causing removal; (c) necessitates reconstruction of stations and team track yards; (d) may necessitate removal of yards. To the owner of industries there is involved the change of arrangement of plant.

It is the prevailing notion that the cost of changing the grade of the railroad is much in excess of the cost of changing the grade of the street and leaving the railroad at the old level.

Cost of Changing Railroad Often Less

This notion is erroneous. It is perfectly clear of course that to elevate a railroad over a single street, or over two or three streets is extremely bad practice regardless of the question of cost, it is equally clear that there are many localities where the cost of elevating the railroad would be in excess of the cost of lowering or raising the streets, but in the average level city, where the change of grade of a mile of track involves the separation of grades of from eight to sixteen streets there is little difference in cost in the case of the lesser number of streets, and where there are many streets per mile the advantage in cost favors changing the railroad. The reasons for this are obvious. The cost in track elevation is largely in the items of grading, masonry or concrete, and carrying traffic during construction. The same three items with the cost of readjustment of street surface and subsurface structures occur where the street is radically changed, and the additional element of damages to property is introduced.

Material for a railroad fill is brought in by train. The cost of steam shovel loading, train haul and unloading will average less than half the cost per yard that the removal of the soil in streets, and its wagon haul to dump scows and dumping will cost. The actual quantities of earth to be moved to fill an entire 100 ft. right-of-way to a height of 20 ft. for 5,000 ft. is approximately the same as would be moved in lowering twelve 60 ft. streets on an equal length of track.

The masonry involved in walls for the railroad fill is of uniform height and standard section, while the street retaining walls, having approximately 10 per cent. more masonry are irregular in height and section and consequently more costly per yard.

The permanent bridges and cost of carrying the railroad traffic during construction are substantially equal in either case, and the cost of carrying street traffic where it must be maintained is less in the case of railroad elevation than in case of street depression.

There remains the question of track reconstruction

and readjustment of industrial tracks, which is more than offset by the cost of rebuilding sewers, water mains, pavement, sidewalks and street railway tracks, and the property damages.

When Cost of Raising Tracks is Excessive

Until one goes into this question fully as the grade separation department has done during the past year it would not appear to be possible, that full elevation of the railroad is the cheapest solution, as far as dollars and cents are concerned. Yet while this statement is fairly true for all railroad rights of way 60 to 100 ft. wide crossing 8 or 9 streets per mile, it will not hold true—

(a) In cases where there are only a few streets per mile and where the railroads have large yards:

(b) In cases where the elevation of the railroad involves the elevation of a large mileage of connecting industrial spur tracks or extensive rearrangement of many factory buildings.

The foregoing discussion leads to the conclusion that from the standpoint of most ideal conditions for the city the full elevation of the railroad tracks is the proper thing, that cost of construction is not only not against the method but this is often the cheapest solution, that inasmuch as the main tracks are elevated for their entire length in the city there is no objection to be urged on account of grade, and that the only reasons that would cause local modification of the plan are:

1. The inability of existing manufacturing plants to adjust themselves to an elevation of 18 or 19 ft., which is likely to occur only in exceptional cases.

2. Difficulties of securing proper team tracks.

These conditions require compromise in such districts as are thickly built with industrial plants or yards.

Separation by Changing Grade of both Street and Railroad

This plan has been adopted in the case of all "Track elevation," so-called, completed or under contract, to date, in Detroit. The tracks have been elevated from 6 to 10 ft. The streets have been lowered from 6 to 14 ft.

The general recommendations for Detroit are as follows:

(a) Nearly complete elevation over important streets.

(b) Compromise elevation at such points as the needs of permanent industries or the consideration of team tracks or other public facilities of the railroads demand.

(c) Moderate elevation or no elevation in such industrial districts as are on one side of through traffic.

Such a programme would really mean—

A. Giving prior consideration to the streets on all through thoroughfares.

B. The complete elimination of all railroad main line grade crossings thus permitting free and fast passage of trains within the city area.

C. Maximum concession to the industries wherever such concession does not perpetuate bad conditions in streets which are, or may become, well used thoroughfares.

With regard to types of construction, the following conclusions are presented:

(a) Streets of 50 ft. or less, where the crossing is substantially a right angle, a clear span without posts.

(b) Streets over 50 ft. or streets on a skew, clear span curb to curb, posts clear of the curb lines.

(c) Extremely wide streets or streets on a bad skew angle, four spans may be permitted and the special type of construction adopted to meet the special conditions shall be approved by the city. Wherever possible driveways shall not be less than 30 ft., measured at right angles to the centre line of the street.

(d) In no case shall abutments for bridges be built within the limits of the street.

(e) Exceptional cases of short streets or driveways to factories may be given individual treatment.

Obtaining Aesthetic Effects

The majority of cities have favored the use of the stone, concrete or brick arch, rather than a structure with straight lines. That there are many arguments in favor of the use of arches in such locations as fine residential sections of the city, parks, boulevards and in locations where the topography admits of ample head room there can be no question.

The use of the arch reduces head room on the sides of the street, and tends to materially lessen the light under the structure. Present day methods of concrete construction insure that with proper specifications a durable and pleasing surface can be secured, and fine artistic effect can be had by the use of good lines and proper finish of materials.

Much thought has been given to questions of design, and it is the conclusion that for a general standard of construction the concrete bridge with simple straight lines, will be far more satisfactory than the arch in nearly all locations and will be subject to such artistic treatment in the way of balustrades or coping as will best conform to the surroundings.

Toronto E. I. C. Hold Smoker

THE members of the Toronto branch of the Engineering Institute of Canada held a lively smoker on Thursday, April 24th, at the Engineers' Club. A report from the Employment Sub-committee was read by Mr. E. T. Wilkie which explained the proposed method of securing employment for engineers out of engagement. After some discussion the report was adopted. Mr. Willis Chipman reported on the work done by a special committee of the institute with the view to obtaining legislation for the registration or licensing of engineers. Further discussion will take place on this important subject.

Several members of the Institute took part in the varied entertainment that was provided after the business meeting.

Britain's Preference Tariff and Its Effect on Canada

In presenting his Budget to the British House of Commons last week, Rt. Hon. Austen Chamberlain, Chancellor of the Exchequer, stated that he proposed to carry out the decisions of the Imperial War Cabinet and the Imperial Conference on Imperial preference. Preference on commodities to be consumed, except alcohol, would be one-sixth of the duty, this preference particularly affecting tea, cocoa and rum. On articles like clocks, watches and musical instruments the preference would be one-third of the duty. The Chancellor announced that a committee would be appointed to consider the rates on food commodities and a number of other articles.

The Chancellor's pronouncement indicates that any

benefit Canada may derive from the establishment by Britain of an Imperial preference will be reaped by Canadian manufacturers rather than by Canadian producers of foodstuffs.

Quebec Association of Architects Do Not Approve Competition

The Council of the Province of Quebec Association of Architects has made a protest against the conditions of a competition for the design of cottages advertised by the city of Outremont. The Council contend that the conditions are unjust to the architectural profession, contrary to the code of the Province of Quebec Association of Architects governing such competitions and unlikely to produce designs creditable to the profession or to the city of Outremont, in the following particulars: 1. That no professional assessor is appointed; 2. That the plans of successful competitors become the absolute property of the city of Outremont. For these reasons the Council of the P. Q. A. A. is unable to recommend its members to take part in competing in this competition.

The Bureau of Water Works of Portland, Ore., has been using cement in place of lead for the joints of its cast-iron water mains. According to the engineer of the bureau, one pound of cement at half a cent per pound will satisfactorily take the place of three pounds of lead at eight cents per pound, so that there is a material saving in cost. The labor of making the joints, however, reduces this saving, because the cement joints have to be kept wet for from 36 to 48 hours. The joint is first packed with yarn and oakum, and then neat cement is forced in.

Trade Incorporations

Border Cities Builders, Limited, head office Windsor, capital \$40,000.

The Summit Sand and Gravel Co., Ltd., capital \$40,000, head office Toronto.

R. Westcott Company, Limited, head office Windsor, capital \$40,000. Authorized to carry on business of contractors, builders and engineers.

J. C. Wilson Mfg. Co., capital \$200,000, head office Belleville. Authorized to manufacture metal castings and to carry on a general foundry business.

Wm. Steele & Sons Company, Limited, capital \$500,000, head office Toronto. Authorized to carry on business as architects, engineers and general contractors.

Trade Publications

Concrete Industrial Driveways—published by the Portland Cement Association. A 12 page pamphlet illustrating and describing the value of concrete driveways in connection with industrial establishments.

The Steel Fence Post, by G. R. Bliss—A four page pamphlet issued by the Steel Fence Post Manufacturers' Association, 10 South La Salle Street, Chicago, telling the advantages and economies of the steel fence post.

The Board of Trade of Winnipeg has issued a folder describing the natural, commercial advantages of Winnipeg and vicinity, drawing special attention to the Greater Winnipeg Water Aqueduct. A great deal of information about the cost, quantities, economic saving and engineering problems of this project, are published in the folder.

Mainly Constructional

East and West—From Coast to Coast

The sum of \$200,000 is to be spent during this summer on harbor work in Hamilton, Ont.

Guelph, Ont., has formed a housing commission to operate under the Ontario Housing Act.

Bridgeburg, Ont., recently appealed to the provincial government for assistance under the Ontario Housing Act.

The rural municipality of Woodnorth, in Saskatchewan, has passed a by-law providing for the issue of debentures to raise the sum of \$190,000 for "Good Roads."

A proposal has been put forward to build a tunnel under the St. Lawrence River at Montreal. The Montreal Chamber of Commerce is unanimously in favor of the plan.

A housing commission has been appointed in Whitby, Ont., consisting of Messrs. F. L. Beecroft, Morton M. Gibson, P. L. S., David Galbraith and Thos. G. Deverell.

The Magdalen River Valley Ry., in Quebec, is having plans prepared for a reduction of gradient at St. Matino du Mount Louis. The cost of this work will exceed \$300,000.

Municipal hospitals are to be built in the towns of Elrose, Wadena, Tribune, Dinsmore and Biggar, in the province of Saskatchewan, ranging in cost from \$25,000 to \$30,000.

Contracts for 160 miles of government railway have been let in Saskatchewan and Alberta, to J. D. McArthur and W. A. Dutton. Arrangements are being made to begin work immediately.

The town of Thorold, Ont., has passed a by-law adopting the provisions of the Ontario Housing Act. Messrs. J. R. Dindwoodie and J. A. Laughlin have been appointed commissioners.

The present St. Patrick Street bridge in Ottawa, which it is planned to replace with a new structure, is to be offered for sale. The new bridge will not likely be erected for a year or two.

It is announced that the British Columbia Gypsum Company intend at an early date to erect a plaster mill to develop their large gypsum deposits at Falkland on the proposed Kamloops-Vernon line of the Canadian National Railway.

Work is being commenced on the 750,000 bushel addition to the Canadian National Elevator at Port Arthur. This will give it a capacity of 6,000,000 bushels, the largest of any structure of its kind. The addition will cost one million dollars.

The basis upon which an agreement has been reached between the Builders' Exchange of Moose Jaw, Sask., and the Bricklayers' and Plasters' Union, is 95 cents per hour till June 1st and from that date till March 31st, 1920, one dollar per hour.

The committee interested in the Ottawa Victory Memorial Hall has definitely decided on the most suitable site for that structure as the space now occupied by the City Hall and extending over the canal and south as far as Laurier avenue. It now rests with the federal and civic authorities to approve of the plan and devise ways and means of acquiring the needed property.

In preparation for the further improvement of the main roads in the province of Saskatchewan, the Department of Highways is endeavoring, with the co-operation of the

reeves and councillors of the rural municipalities, to obtain a record of all gravel deposits in the province.

The plans of the civic works committee of Winnipeg, if carried out, will involve an expenditure of approximately \$400,000 for local improvements. This is more than six times the amount spent on this class of work by the city last year. Many important thoroughfares are to be repaired and improved.

St. Vital, Man., is requesting that the adjacent city of St. Boniface lay water mains on Carriere St. and allow St. Vital to connect up with the Shoal Lake water supply from the Greater Winnipeg aqueduct. The St. Boniface council instructed their engineer to make a report regarding the cost.

A concern being incorporated under the name of the Great West Natural Gas Corporation, Ltd., contemplates a project for piping natural gas from western Saskatchewan to Winnipeg and cities en route. Geo. A. McKenzie, of Calgary, is the representative of the company, who has the enterprise in hand.

The proposal has been put forward in Winnipeg to replace the Maryland bridge over the Assiniboine River, and City Engineer Brereton is considering plans for a single-span structure. The present bridge was built in 1895 and cost \$40,000, and it is estimated that the proposed new structure would cost about \$150,000.

The Ontario Legislature has set aside the sum of \$5,000,000 to aid in the improvement of public highways and for the payment of grants or expenditures for that purpose, as provided by the Highway Improvement Act, the Ontario Highways Act, and any other Act for the construction, acquisition or improvement of public highways.

While a deputation recently petitioned the government for a railroad line from Swastika to the Kirkland Lake Camp in Northern Ontario, it now appears that the majority of the property owners in the district are favorable to the construction of a motor road instead. This was demonstrated by the vote taken at a recent mass meeting in Cobalt, Ont.

New Toronto plans to enter into operation under the Ontario Housing Act as soon as possible. The council has asked Messrs. James, Loudon and Hertzberg to submit plans of four types of houses—two detached and two semi-detached, to cost, inclusive of land, \$3,000 to \$3,600. Fifty houses will be built at once. The amount expected from the government is \$175,000.

Mr. G. Fred Goodspeed, district engineer of the Department of Public Works, has suggested, as a means of maintaining a channel across the Oromocto shoals on the St. John River, that a wing dam be constructed at the head of Oromocto Island, slanting towards the Maugeville shore. The city of Fredericton has been requested to submit data as to the advantages which would accrue from this work.

A stretch of 16 miles of road is being built from Naperville to St. Hyacinthe, P. Q. This runs via St. John, Baptiste and St. Madeline to St. Hyacinthe. Besides this northerly route the residents of this locality are asking for a southerly route via Rougemont and St. Damase, which would be about 16 miles. A road connection from St. Hyacinthe to Drummondville is also being urged, this being a distance of some 25 miles.

An executive meeting of the Canadian Good Roads Association was recently held in Toronto to complete preparations for the Good Roads Congress and Exhibition, which is to be held in the Parliament Building, Quebec, May 20-22. Word has been received from delegates from all the provinces, except Alberta, that they will attend the convention. Many prominent engineers and road construction men from

all over Canada and from the United States are also expected to attend.

Fire losses in Ontario showed a marked decrease for the first three months of the year, as compared with previous years. During the quarter there were 2,226 fires, with a total loss of \$2,029,073, of which \$1,526,345 was covered by insurance. This compares with a 1918 record of 2,529 fires, a total loss of \$3,194,300, and an insured loss of \$2,634,318, and a 1917 record of 2,583 fires with a total loss of \$3,282,161, and an insured loss of \$2,525,674. The uninsured loss for the past three months was only \$502,728.

It is announced that 350 miles of branch lines will be built in Saskatchewan this year by the Canadian National Ry. It is the intention to take up 350 miles of 60-pound rails on the main lines and replace them with 85-pound rails, the lighter rails to be used on the proposed branch lines. The branches to be built are as follows: Gravelbourg to Neidpath; Elstow to Kyleville; Dunblane to Sunkist; Elstow to Alsack; Lake Linore to Humboldt; northeast from Melfort and Peebles to South Handsworth.

A report has been submitted to the council of Point Grey, B. C., by Municipal Engineer Greig, regarding the grading of Alma Road to make it suitable for a line of the B. C. Ry. Five possible schemes were suggested, costing as follows: Timber trestle work, \$30,975; wooden bulkheads and fill, \$40,000; reinforced concrete trestle, \$53,475; mushroom concrete viaduct, \$104,775; concrete bulkheads and fill, \$116,475.75. By undertaking this work the grade on the road may be reduced to 7.5 per cent.

A number of the Masters Painters' in Toronto have agreed to meet the striking workmen's demands for a minimum wage of 65 cents an hour, a 44-hour working week, time and a half between 5 p. m. and 10 p. m. and double time between 10 p. m. and 8 a. m. Representatives of the employers and the union will form what is to be known as an adjustment board, and if the board fails to agree with respect to agreements or disputes between the two parties at issue, the question will be referred to either an independent referee or an independent tribunal.

Appropriations totalling \$280,000 have been passed in Toronto for additions to schools now congested. This expenditure will be distributed as follows: Bedford Park school, \$50,000, six rooms to be added at the rear, and a principal office and medical inspection to be added at the front on either side of the main entrance; Duke of Connaught, \$45,000, six rooms, 3-storey addition; Norway, \$45,000, six-room separate primary building to be erected on school grounds; Earl Grey, \$50,000, six rooms to be added; Wilkinson, \$90,000, administrative portion and additional rooms to be added to north side of building.

Toronto's housing commission has permission to proceed with a housing scheme independent of the Ontario Housing Act. A deputation representing the city council, the board of trade, and the G. W. V. A., was given assurance recently by Premier Hearst that legislation to validate this action would be introduced at the next session of the Provincial House. The members of the deputation pointed out that a scheme which was applicable to the rural districts of the province would not be practicable in Toronto, one difficulty being the high price of land within the city. It is therefore proposed that the city itself finance a scheme which will suit its peculiar conditions.

Fifty-four entries, covering a total of 117 miles, have already been received for the Manitoba split log dragging competition. The Good Roads Association is contributing \$200 towards the prizes; the T. Eaton Co., \$100; Robinson & Co., \$50; and several other concerns have promised to consider the donation of straight cash instead of merchandise

prizes. In addition to the money prizes, the Birks shield and the Banfield cup, which are annually competed for, will be awarded. It was also announced that the provincial government has agreed to give \$3.25 per mile to municipalities systematically maintaining their roads by split log dragging, and further, that experts in split log dragging would be appointed to go from municipality to municipality instructing the contestants in the correct use of the implement.

The latest information we have received from Mr. W. Ross MacKenzie, secretary of the Regina Builders' Exchange, regarding the labor situation in that city is as follows: "The strike is still on here, but there would seem to be sufficient men to carry on what work is offering. No doubt the strike has held up thousands of dollars worth of work this spring but that seems to be the condition everywhere. The bricklayers demanded a 44-hour week at \$1.00 per hour (8 hour day 4 on Saturday) and the Builders' Exchange offered them 95 cents per hour until June 1st and \$1.00 per hour from then to March 31st, 1919. The demands of the other trades have not been met yet as we are under the impression that once the bricklayers strike is settled, it will be a basis for all the other trades. Moose Jaw accepted what was offered to them."

Personals

Mr. E. Drinkwater, consulting municipal and highway engineer, informs us that he has closed his Montreal South office, and reopened at rooms 212-13, 180 St. James Street, Montreal.



Mr. Ivan E. Vallee, appointed Chief Engineer and Director of Railways, Department of Public Works, Quebec, and also Engineer of Quebec Public Utilities Commission.

Lieut.-Col. C. H. Mitchell, the newly appointed Dean of the Faculty of Applied Science and Engineering of the University of Toronto, has now been promoted to the rank of Brigadier-General.

The general contracting firm of John Flood & Son, St. John, N. B., will carry on business in the future under the name of John Flood & Sons, Mr. John Flood, civil engineer, having been admitted to the partnership.

Major Geo. McNamara, of the firm of McNamara Bros., contractors, Sault Ste. Marie, Ont., who has recently returned from the front after three years of service, was married on April 29th to Miss Florence Agnes McLarney, daughter of the late Hugh McLarney, U. S. customs officer, and Mrs. McLarney, of the same city. Major McNamara is well-known in sporting circles throughout Canada.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Arnprior, Ont.

Town Council plans construction of concrete walks and macadam roadway, \$6,000. Clerk, F. H. Grout.

Belleville, Ont.

City Council plans construction of sewers to cost about \$25,000.

Brampton, Ont.

Tenders received by town clerk, C. M. Corkett, until 6 P. M., May 12th, for construction of pavement, curbs, etc.

Gorrie, Ont.

Plans and specifications are with township clerk, C. E. Walker, who is receiving tenders until May 21st, for construction of drainage system.

Hamilton, Ont.

City Council plans paving part of Maple Ave., \$3,000. Engineer, E. R. Gray.

Ingersoll, Ont.

Town Council plans concrete paving Thames and Noxon Sts. Clerk, W. R. Smith.

Joliette, Que.

County Council plans construction of road from here to Berthier, 16 miles. Engineer, M. Henry, Road Dept, Quebec.

Mimico, Ont.

Tenders received by clerk, J. A. Telfer, until noon, May 17th, for pavements, \$50,000. Plans and specifications with engineers, James Loudon & Hertzberg, Excelsior Life Bldg., Toronto.

Point Grey, B.C.

Department of Public Works, Victoria, plans paving Marine Drive from Point Grey boundary to New Westminster. Minister, Hon. J. H. King, Victoria.

St. Catharines, Ont.

Tenders received by Chairman of Board of Works, until 5 P. M., May 14th, for approximately 45,000 square yards of pavements and 25,000 lineal ft. of curbs and gutters for City Council.

St. Chrysostome, Que.

Specifications, etc., are with sec.-treas., J. E. Derome, who is receiving tenders until 2 p.m. May 12th, for macadamizing $5\frac{1}{2}$ miles of road for Municipal Council.

St. Valentin, Que.

Tenders will be called soon for construction of macadam road for Municipal Council. Sec.-treas., Alexis Gregoire. Engineer, M. Henry, Parliament Bldgs., Quebec.

Saraguay, Que.

Town Council plans construction of $1\frac{1}{2}$ miles of road. Mayor, Major Hooper, 36 Charboillez Sq., Montreal.

South Vancouver, B.C.

Municipal Council plans paving Main St. Sec.-treas., W. T. Riley.

Victoria, B.C.

Plans are drawn for paving and side-

walks, \$90,000, for City Council. Clerk, W. M. Bradley.

CONTRACTS AWARDED

Caledonia, Ont.

Road, \$96,800.—County Council has awarded contract for thirteen miles of road to McConnell & Kracklin, 6 Washington Ave.

Listowel, Ont.

\$35,000 pavement for County Council: General contractor, W. C. Brennan, 100 Melrose Ave., Hamilton.

Sherbrooke, Que.

Sewers, \$35,000.—City Council has awarded contract for pipe to J. S. Mitchell & Co., Wellington St., and Codere Sons & Co., Wellington St.

Strathroy, Ont.

Pavements.—Town Council has awarded contract to Warren Bituminous Paving Co. of Ontario, Ltd., McKinnon Bldg., Toronto.

Railroads, Bridges and Wharves

Banff, Alta.

Plans are in progress for \$100,000 bridge for Department of Public Works, Ottawa. Secretary, R. C. Desrochers, Ottawa.

Cape Bald, N.B.

Tenders received by R. C. Desrochers, secretary of Department of Public Works, Ottawa, until noon, May 20th, for repairs to breakwater pier.

Fergus, Ont.

Tenders received by clerk, Jas. Beatie, until May 14th, for erection of bridges for Wellington County Council. Engineers, Bowman & Connor, 31 Queen St. W., Toronto.

Tenders received by J. M. Kearns, Reeve, Arthur, Ont., until May 13th, for erection of five concrete bridges for Wellington County Council. Engineers, Bowman & Connor, Toronto.

Gifford, B.C.

Municipal Council of Matsqui plans erection of bridge. Sec.-treas., John LeFleuvre, Matsqui.

Moncton, N.B.

Tenders are called for double tracking railway from here to Truro, about 120 miles, for Canadian Government Rlys., Toronto. General superintendent, L. S. Brown, Moncton.

St. Henri De Taillon, Que.

Municipal Council plans erection of steel bridge. Engineer, Yvan Vallee, Parliament Bldgs., Quebec.

Stewart, B.C.

Department of Public Works, Ottawa, has included in estimates \$34,000 for construction of wharf. Secretary, R. C. Desrochers, Ottawa.

Thessalon, Ont.

Tenders received by R. C. Desrochers, secretary of Department of Public

Works, Ottawa, until noon, May 26th, for reconstruction of wharf.

CONTRACTS AWARDED

Comber, Ont.

Three bridges and drainage work for Township Council: General contractor for bridge work, \$8,150, Wm. Burnard, Township Clerk, S. T. Anderson.

St. Thomas, Ont.

Highway bridge for Elgin County Council: General contractor, J. W. Chivers, Belmont.

Public Buildings, Churches and Schools

Alexandria, Ont.

Kenneth G. Rea, Architect. Beaver Hall Hill, Montreal, is preparing plans for \$75,000 hospital for Archie Chisolm.

Athol, N.B.

Plans and specifications are with architect, R. A. Frechette, 30 Bonnacord St., Moncton, who is receiving tenders until May 20th, for erection of \$12,000 church for R. C. Congregation of Chatham.

Barrie, Ont.

School Board plans erection of school, \$40,000 to \$50,000. Architect, R. J. Edwards & Edwards, 18 Toronto St., Toronto.

Belleville, Ont.

J. P. Hynes, 105 Bond St., Toronto, has been appointed architect and is preparing plans for hospital for St. Michael's Church Congregation.

Brantford, Ont.

Zion Presbyterian Church plans erection of Sunday school. Chairman, C. J. Watt, care Geo. Watt & Sons.

Bridgewater, N.S.

Plans and specifications are with clerk, Jas. A. Curll, who is receiving tenders until May 20th, for erection of \$100,000 memorial hospital for Town Council. Architect, Leslie R. Fairn, Aylesford.

Burlington, Ont.

Plans and specifications are with architect, J. A. Armes, 7 Hughson St. S., Hamilton, who is receiving tenders until May 12th, for erection of school for School Board.

Calgary, Alta.

Tenders received by Secretary, until noon, May 14th, for the demolition of present buildings and excavation work for public building for Department of Public Works, Ottawa.

Courtland, Ont.

Tenders received by township clerk, D. W. White, until noon, May 19th, for erection of \$6,800 memorial hall.

Edmonton, Alta.

City Council plans improvements to exhibition building, \$14,000. Mayor, Jos. A. Clarke.

Falls View, Ont.

Plans will be prepared for \$22,000 gym-

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Westmount Modifies Apartment House Building Restrictions

THE city of Westmount has modified its building by-laws with a view to encouraging the construction of apartment houses. Areas for apartment houses are created, in which given classes of houses will be allowed. Thus in one district three-storey apartment houses may be constructed; in another, apartments not exceeding six storeys in height; while in a third, flats not exceeding two storeys will be allowed. The restrictions in regard to the construction of apartment houses will also be greatly modified. Those of two storeys will be permitted with second-class construction. Three-storey apartments will be permitted with second-class construction, provided the ground floor is of concrete or other non-combustible material, and the stair-wells, chutes and shafts are of non-combustible material. Four-storey apartment houses will be allowed with second class construction, provided all floors are of concrete or other non-combustible material, and the same material used

for stair-wells, chutes and shafts. Five and six-storey apartment houses will have to be of first-class construction, entirely fireproof.

Saskatchewan Government Makes Grants to Assist Road Maintenance

HON. J. S. LATTA, Minister of Highways, for the Province of Saskatchewan, is sending out a bulletin to all the rural municipalities in the province, urging immediate action in locating main highways, so that the Provincial Government grant of \$500 to each municipality for the maintenance of main highways can be made available. The Highways Act was amended at the last session of the legislature in some important particulars to assist in the furtherance of the good roads policy of the department. Section 8, sub-section (1), as amended, provides that:

'For the purpose of assisting in the maintenance of main highways leading to market towns, and subject to the provisions hereinafter contained, there shall be paid by the department out of any legislative appropriation made for public improvements chargeable to income, a grant in each year of \$500 to each municipality comprising nine townships, and a grant to each municipality comprising more or less than nine townships of a sum bearing the same proportion to \$500 that the number of townships does to nine.'

Before all or any part of this sum can be available for any municipality it is absolutely necessary that the municipal council shall pass a resolution setting forth how and where the moneys shall be expended. On or before the first day of June a copy of such resolution, certified as correct by the secretary of the municipality, shall be forwarded to the Department of Highways.

Programme of Harbor Improvements for Montreal

THE Montreal Harbor Commissioners have now completed the programme of improvements for the present year. Owing to the war, the work, involving the expenditure of nine million dollars, was held up. The programme includes the commencement of the electrification of the railway tracks; more ample wharf and pier accommodation, and new transit sheds and cold storage accommodation.

The sum of \$150,000 will be spent on the construction of extensive railway sidings to accommodate the large increase in railway business being transacted through the port. The scheme adopted provides for the extension of the Alexandria, King Edward and Jacques Cartier piers. This will enable them to accommodate on either side two of the largest vessels navigating the St. Lawrence. As Jacques Cartier pier is the shortest, it will be the only one to be extended during the present season. The shore wharves from section 25 to section 30 will also be further extended, and 2,500 feet of concrete wall will be built between these sections. The old wharves between these points at the present time are only 15 feet wide, owing to the construction of the high level embankment thereon. The new wharves will have a width of at least 150 feet and will provide berthage for another six ocean liners. The commissioners will begin the foundations in the course of a few days for new sheds, Nos. 17 and 18, on the Victoria Pier, which will be each about 450 feet long by 100 feet wide, two storeys in height, and

equipped with grain conveyor facilities. These sheds will be in readiness for operation upon the opening of navigation in 1920.

A large new public warehouse and cold storage is to be constructed at Beaudry Street. High and low level entrances will give equal facilities to lake and ocean carriers, and immediate access will also be had to the harbor railway system, which connects with all railway lines. The building will be 426 feet long by 106 feet wide, 8 storeys in height. Four storeys will be insulated, and three storeys utilized for dry storage, the remaining flat being used for offices, stores distribution area, tracks, roadways, etc. The cost will approximate \$1,500,000.

The depth of the channel is being increased from 30 to 35 feet, and the harbor is also being deepened by continual dredging.

Housing Action in Great Britain

THE corporation of Manchester, England, recently bought an estate of about 106 acres for housing, paying \$2,250 an acre. The schemes approved by the City Council, provide for 7,400 houses, and additional projects that can probably be put through quickly will bring the full number of the houses entitled to the Government subsidy to 10,000. Another 7,000 houses will be required later. The amount of the subsidy is to be the amount of the annual loss in excess of the two-cent tax rate, the city having to forego taxes on the property. The annual loss will depend on the rents that are charged, and there is no standard of rent in the Housing Bill. The city intends to fix the rents of the new corporation houses at 100 per cent. above the pre-war level, and houses with four bedrooms will be \$4.15 a week, rates compounded. It is pointed out that the increased cost of building will have the effect of increasing the rateable value. The cost of building is calculated at 150 per cent. over the pre-war standard, although if the work were undertaken at the present time the difference would be at least 180 per cent., and possibly 200 per cent. The Public Health Committee, however, anticipates a decrease in costs before the work is commenced.

State Will Provide Over Seven Millions

An official calculation on the basis above mentioned shows that on the first 2,000 houses that are to be built the annual loss will be nearly \$240,000 a year, and at the same rate the loss on 10,000 houses would be \$1,200,000. Deducting the \$90,000—equivalent of tax rate—which must be a local burden, there will remain \$1,110,000 a year to be found by the national exchequer. The state will bear that charge for seven years, making its total liability for this particular scheme \$7,770,000. At the end of those seven years there will be a survey of the property, and its capital value will be written down to a point at which no further annual loss will be incurred. Just what this will involve is not clear.

Glasgow Needs 55,000 Houses

Another city in which the housing problem is particularly acute is Glasgow. The scarcity is not confined to any one class of dwelling, but it is felt most among the working people. Small tenement houses of two, three and four apartments are unobtainable in the city. It is calculated that to meet the present

needs something like 55,000 new houses are required, but it is not expected that anything near that number can be erected in the near future. The corporation has designated close on 1,000 acres of land for residence purposes and has announced a competition for architects, civil engineers and others in connection with this undertaking. Thirty thousand dollars is allotted for prizes and premiums, of which \$20,000 will be awarded for working plans, models, drawings, illustrations and descriptions, and \$10,000 will be spent on the acquisition or preparation of essential aids to the thorough investigation of housing in the city. This competition is being conducted in connection with a housing and health exhibition, which is to be held this autumn, and altogether it comprises nine separate schemes. The proposals contemplate the erection of cottage homes as well as tenement buildings. Models with relative plans are invited of semi-detached cottages of four and five apartments each, of two-storey blocks containing two houses of three or four apartments on each storey, and plans of houses so fitted and equipped that there will be a minimum of movable furniture to be provided by the tenant.

The carrying out of these proposals will occupy some considerable time, and the corporation have pointed out to the Local Government Board that it is impossible to undertake the building of such a large number of houses in two years. They have, therefore, suggested that a reasonable guarantee should be given that the option of the board to extend the period of two years, during which State assistance may be given, will be exercised to, say, not less than seven years.

When the full building programme in Great Britain is under way, it is thought it may possibly be necessary for the Government to ration the supplies of materials.

New Bridge for Winnipeg Decided On

THE Winnipeg Board of Works have decided upon the replacement of the Maryland bridge over the Assiniboine River with a new structure. A bridge was planned some time ago by the city engineering department in collaboration with the Greater Winnipeg Plan commission, the architectural features being designed by Arthur A. Stoughton. Estimates of cost are to be secured on this design, or a modified one if the Assiniboine is declared by the government to be non-navigable. The axis of the bridge will be changed somewhat, the north end being moved to the east. Small strips cut from the edges of Cornish park and the neighboring properties will then permit of curves of large radius, by which two lines of car tracks leaving the bridge may be carried into Sherbrooke St. much more conveniently than at present, a similar wide curve into Maryland Street tending to draw vehicular traffic along that route. An island with an ornamental pier serving as sign board and light standard, directly opposite the portal of the bridge, will divide the traffic. The architectural treatment of the structure, as designed, consists of two simple piers at each end, carrying great lamps, with the parapet walls extending between, interrupted by semi-circular niches with seats over the piers. These niches are flanked by the ornamental lamp standards and lamps in pairs, each pair being connected together by wrought iron tracery.

Eaton Mail Order Building, Moncton, N. B.

General Description of Large, Six Storey Flat Slab Reinforced Concrete Warehouse for T. Eaton Co.

EXCAVATIONS are now being carried out for the large six-storey mail order building at Moncton, N.B., for the T. Eaton Co., Ltd.

When completed this structure will take care of the growing mail order business of the Eaton Company in the eastern part of Canada. In design and layout it is arranged to accommodate this particular type of business and there will be such facilities and equipment as will expedite the handling of mail order merchandise. Provision will be made for future extension so that the building may keep pace with the growth of the business.

Flat Slab Reinforced Concrete

The building is about 161 ft. by 240 ft., the west or main facade fronting on Foundry Street, with the east side or rear, conveniently located adjacent to rail-

side of parapet walls, etc., will be faced with stretcher brick. The moulded base course at grade, door and window sills and platform facing at main entrance, are to be of granite, while limestone work is to embrace facings on the ground floor entrance bays, window sills and lintels, cornices, belt courses, pier bases, wall copings, cornice abutments, keyblocks and springer blocks. On the rear walls concrete sills will be used instead of limestone. The illustration reproduced herewith gives some idea of the external appearance of the completed building.

The building contains a large light-well about 60 ft. x 100 ft. on the south side. On the ground floor only, the well is roofed over to provide a shipping area beneath.

In the basement on the east side adjacent to the



How the Eaton mail-order building will appear when completed

way tracks. The Foundry St. front contains the main and employees' entrances and a driveway. In height the building is six storeys and basement. The design is of the flat slab reinforced concrete type, similar to the recently completed buildings for the same company at Toronto. In exterior appearance the structure will be made quite imposing by the use of limestone trimmings and brick facings.

The north and west elevations, which are the principal elevations, as well as one bay returns on the east and south elevation, will be veneered with facing brick. The lightwell elevation, east and south elevations, beyond the one bay returns and all unimportant or unseen walls, such as pent house elevations, roof

railway tracks, are located the boiler and engine rooms. The installation of three boilers is provided for, with coal storage in bunkers beneath an exterior platform. The engine room has accommodation for two 62½ kw. generators; one 125 kw., d.c. generator, and a motor generator set. The regular boiler and engine room auxiliaries will be installed and provision is made for the future installation of stokers.

Shipping Facilities

Very complete shipping facilities are arranged for on the first or ground floor. From the Foundry Street front, a driveway approach leads to the wagon and shipping area alluded to. This measures about 30 ft.

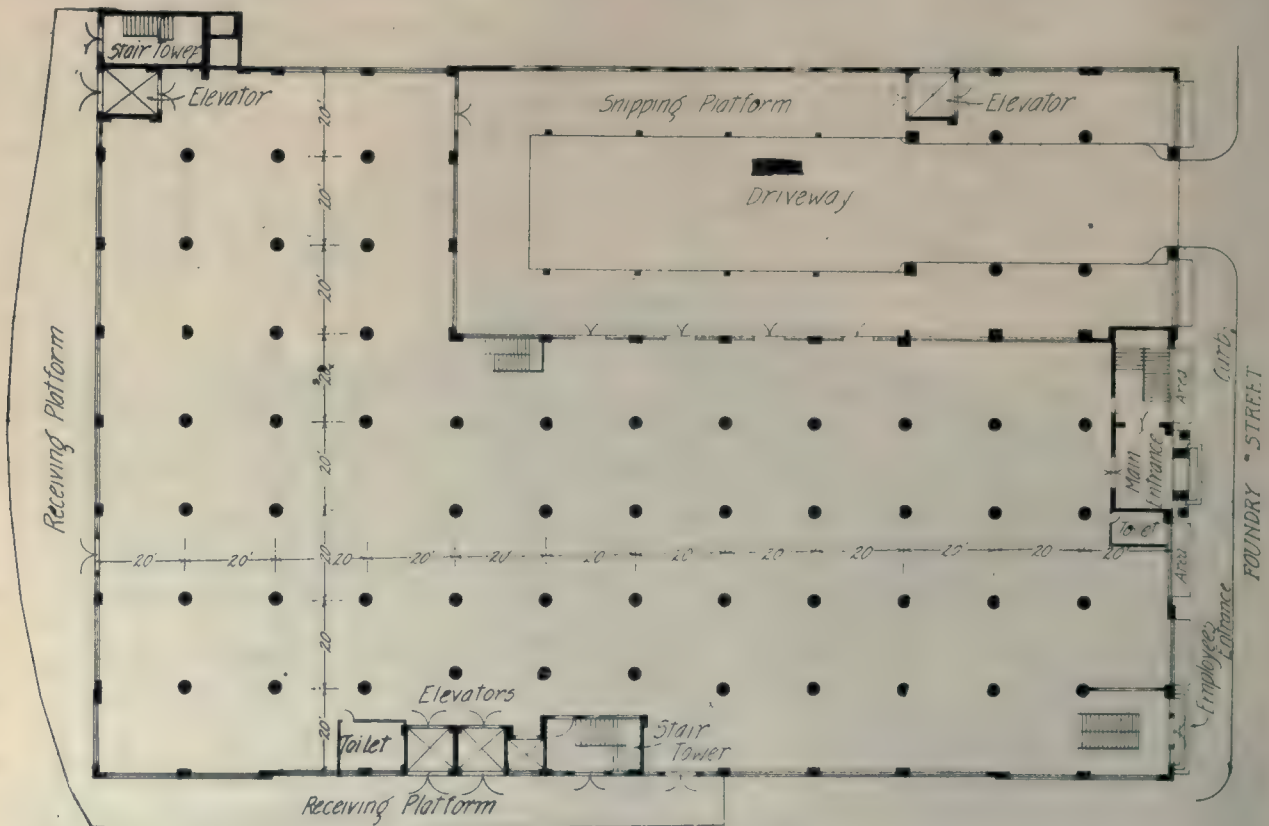
wide by 140 ft. long and is surrounded on three sides by a 15 ft. wide shipping platform. Five doors give access to the platform from the building proper. On the south side, which will be the party wall between the building and any future addition, arrangements are made for doors to be inserted when required. In the meantime, the openings will be bricked up. An elevator is located so as to serve this shipping area. On the north and east sides there are receiving platforms arranged with elevator service. Five elevators are provided for altogether.

The remaining floors are typical, the lightwell being carried up over the shipping area. This is roofed over at the second floor level by a slag roof with copper skylights glazed with wired glass over the platforms.

Three enclosed stair-towers run to the top floor. The steps are fitted with safety treads and gas pipe

mit the building being extended at some future time. The interior columns are circular in section, while the wall columns are rectangular. The typical columns measure in diameter 34 in., 32 in., 30 in., 28 in., 24 in., 24 in., 24 in., in basement to sixth floors respectively. The reinforcement comprises spirals and longitudinal rods. All the columns have flaring capitals and drop heads, 4½ in. deep by 7 feet 8 in. square.

The floor slabs are 6¾ in. deep and the roof is 6 in. The reinforcement layout comprises diagonal and rectangular bands of bars in the lower part of the slab to take the main slab stresses. For the reinforcement of the slab against the negative moment over the column, a separate mat or cross frame of bars is located over the column head near the top of the slab. This mat comprises straight bars in two directions, and has no connection with the bottom slab steel. The bars in both the bottom and top of the slab overlap



First floor plan of Eaton building

railings are installed. Steel sash on the interior walls provide borrowed light.

Rolled steel sash with ventilators are to be employed throughout. For handling merchandise there are spiral chutes connecting all floors. Ample lavatory accommodation is designed for each floor with marble wainscoting and partitions and terrazzo floor. On the second floor are offices above the main entrance.

Structural Design

The entire building is constructed of reinforced concrete on the flat-slab design. The footings rest on firm clay just below basement floor grade. They vary widely in dimensions, but the typical one is 10 ft. 6 in. square and 2 ft. 8 in. deep, surmounted by a 3 ft. 3 in. x 3 ft. 3 in. x 1 ft. 2 in. block carrying the column. The footings on the south side are arranged to per-

sufficiently on each side at the line of inflection, as established by uniform loading, to provide a zone for the travel of the line of inflection which is reinforced at both top and bottom of the slab. This reinforcing scheme is the same as that followed in the T. Eaton factory in Toronto, a description of which appeared in the "Contract Record" of June 27, 1917, page 553.

The designed live load is 120 lbs. per square foot. Maple flooring on 1 inch rough floors and 2 x 4 sleepers is laid on the slab on all floors except the first, where a 1 inch cement top coat is provided. Columns and corners on all floors likely to be damaged by the handling of merchandise are protected with fenders. The typical bay is 20 ft. square and the storey height is 14 ft.

The design for the building was carried out by Wm. Steele and Sons Company, architects and engineers, Toronto.



Fig. 1—Wilson Bridge, Lyons, France.

Wilson Bridge Combines Stone and Concrete

Six Span Arch Structure Over River Rhone Has Masonry Arches, Cut Stone Trimmings and Hennebique Type Concrete Deck

THE Wilson Bridge, so called in honor of the President of the United States, spanning the River Rhone at Lyons, has recently been completed. This bridge is a very fine example of the combination of masonry and reinforced concrete construction. The architectural treatment displayed is very much to be admired.

This bridge was erected to replace the City Hall Bridge, built in 1838 by the Compagnie des Ponts Sur le Rhone. This old bridge was of the suspension type, 23 ft. 4 in. between the hand rails, and was no longer capable of carrying the existing traffic, and, further, the wrought iron anchors sunk in the masonry of the bridge abutment could not be inspected. It was probable that these anchors were in bad condition, endangering the public security.

It was decided that the new bridge should be built on the exact location of the old one, and in view of the importance of the traffic at this point a temporary bridge was built to accommodate this traffic until the completion of the new structure. Work was commenced on the temporary structure on May 24, 1911, and the work of demolishing the old bridge was commenced on April 15, 1912.

The main structure of the new Wilson Bridge is

750 ft. in length between the abutments. It consists of four arched spans, averaging approximately 150 ft. in the clear, together with two elliptical arches, one 25 ft. span on the right bank and the other a 38 ft. span on the left bank. The bridge is 66 ft. wide between the parapets, having a 36 ft. roadway and two sidewalks of 15 ft. each. The roadway carries two electric car tracks of one meter gauge.

The river piers are founded on caissons sunk by compressed air to a depth varying between 33 ft. and 40 ft. below low water mark, according to the nature of the soil encountered. The sinking of the caissons presented no special difficulties.

The main spans, averaging 150 ft. in the clear, consist of two masonry arches (See Fig. 1), 16 ft. 6 in. wide, having an open space of 35 ft. 4 in. between them. The pilasters, entablature, cornices, parapet and other ornamental work are all of cut Comblanchien stone. The entire decking of the bridge is constructed in reinforced concrete, on the Hennebique System.

The masonry arches were first built, as shown in Fig. 2, and following their completion the cross spandrel walls, also built in masonry, together with the small spandrel arches, were constructed. On this sub-

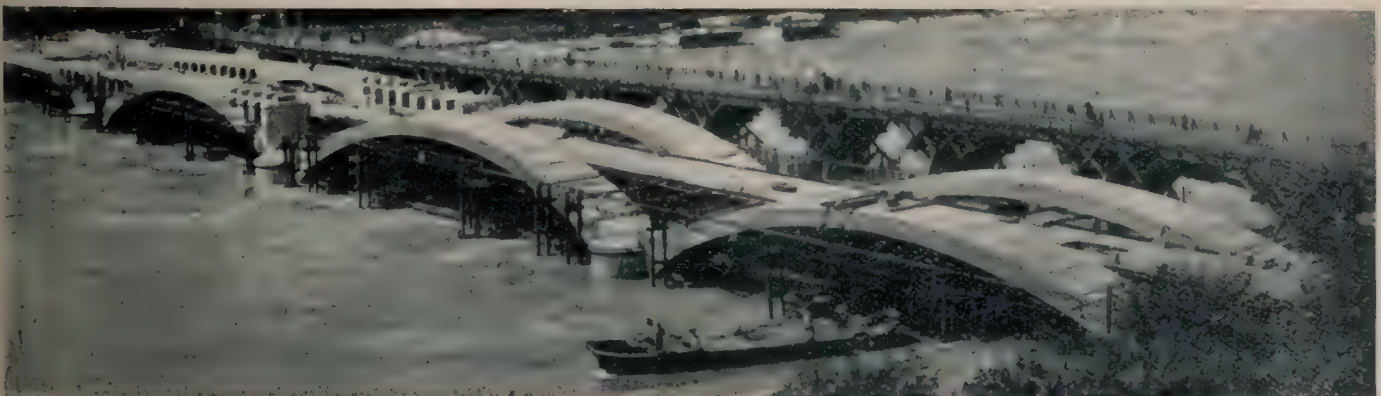


Fig. 2—The masonry arches before placing of reinforced concrete deck

structure the reinforced concrete decking was cast in place.

Deck System

This reinforced concrete decking has a total area of 4,340 square yards; it is 730 ft. long by 53 ft. 6 in. wide. It is carried on main beams, bearing on the cross spandrel walls and on the masonry arches direct about 8 ft. 10 in. on centres. Great care has been taken to ensure that the load of these main beams shall be properly distributed on the masonry arches. The bearing, 20 in. x 27½ in., was formed on the centre line of the masonry arch and a layer of lime mortar ¾ in. thick was placed to permit casting of the reinforced concrete beam directly on the masonry. After the concrete had set the lime mortar was removed, so that the beam is absolutely clear of the masonry arch and spandrel walls except at the bearing on the centre line of the arch.

These main beams are 52 ft. span, and compare in their form of construction to a steel fish bellied plate girder. They are 5 ft. 7 in. deep at the centre and 3 ft. 1½ in. deep at the portion overhanging the masonry construction, except at the crown at the arch, where this latter depth is reduced to 27½ in. The upper member is 13 in. wide and 14 in. deep, and the lower member is 12½ in. wide by 10 in. deep. The uprights, or stiffeners, are 10 in. x 14 in., and the web is 4 in. thick.

These beams are connected at their bearings by a cross distributing beam of similar formation, but having parallel top and bottom members. This beam serves to distribute the load and gives great monolithic strength to the deck structure.

The roadway slab, 6¼ in. thick, is divided into five panels by four longitudinal beams 8 in. wide x

tar. After the concrete had set the lime mortar was removed, giving the open space as required.

Two closed conduits 4 ft. 7 in. x 4 ft. 11 in. are formed underneath the sidewalk adjacent to the parapets of the bridge by the distributing beam and dwarf masonry walls. Access is provided to these conduits by manholes in the sidewalk. These conduits are thus made easily accessible for the use of water, gas and electric light mains and telephone conduits.

As shown in Fig. 4, the street car rails are set in asphalt direct on the reinforced concrete decking and concreted into position. Stubs left in the reinforced concrete deck are bent over to reinforce the concrete holding the rail in position. Short lengths of rod are set in the rail itself to further anchor same to the concrete. The head of the rail is set in composition to prevent the action of the water.

This method of laying track is very interesting to us in Canada, as it materially reduces the cost of construction and promises to be very effective against water and frost action.

The form work was all made in sections, and was re-used as far as possible. The forms were removed at the end of twenty days from the secondary beams and decking, and at the end of five or six weeks from the main girders.

As the forms were re-used many times, any complication of same in the panelling of the main girders has been largely discounted and the fullest advantage taken of the lightness and monolithic strength of reinforced concrete as a material of construction.

Tests for Deflection

The specifications demanded that the bridge should be tested, and that the deflection should not exceed

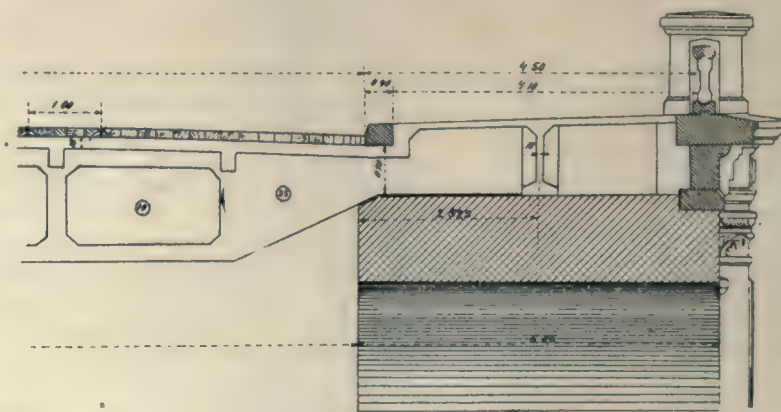


Fig. 3—Half section at centre line of arch

10 in. deep, 7 ft. 10½ in. on centres. The sidewalk slab is 3¼ in. thick and is finished with asphalt, the outer edge bearing on the dwarf masonry wall carried by the spandrel arches.

The sidewalk curbs were formed in cut stone. The roadway decking was floated with cement mortar and finished with wood block paving set in pitch.

Provision for Expansion

There are two expansion joints at each pier of the type shown in Fig. 4. The reinforced concrete decking over the arched spans was constructed first. The expansion joints were then placed in position and the concrete decking over the piers completed. The open space at the expansion joint was maintained by placing a layer of lime mortar held in position by thin sheet iron, so that the concrete decking at the piers should be cast directly in place against the lime mor-

1,000th part of the span, and 24 hours after the removal of the load the permanent set should not exceed one 2,000th part of the span at a load of 82 lbs. per sq. ft. over the whole area of the bridge (roadway and sidewalks).

The bridge was tested to live load of 123 lbs. per sq. ft. or 50 per cent. in excess of the specified live load. Three deflectometers were placed in position under the main beams tested, and gave the following results after 12-hour tests.

Middle of beam:—deflection ... 1-3/16 in.

Up stream side:—deflection ... 7/8 in.

Down stream side:—deflection ... 25/32 in.

After 24 hours there remained only 1/32 of an inch permanent set at the centre of the beam. There was no apparent deflection at all in the sidewalks. Rolling load tests were also applied.

The tests revealed that the actual deflection was

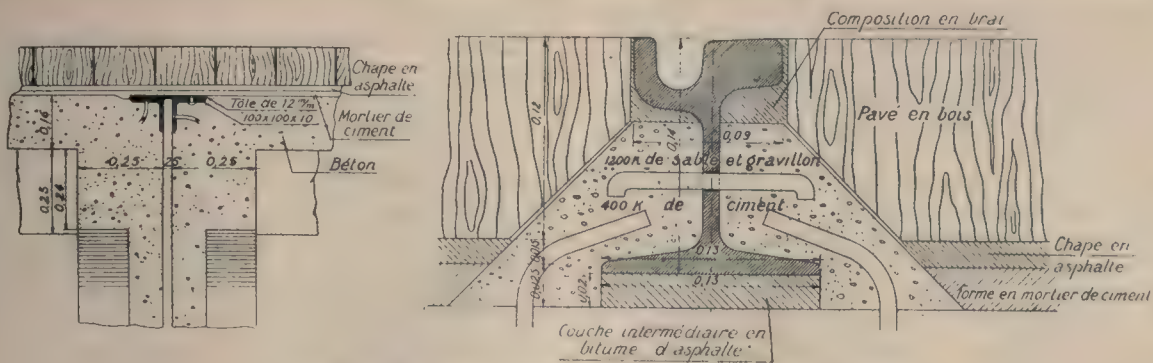


Fig. 4—Left, expansion joint construction; right, setting of rails

only 1/50th part of the deflection permitted in the specifications.

It was fitting that the opening ceremony of the bridge took place on the 14th of July, 1918, which is the great French national holiday in commemoration of the fall of the Bastille, 1789. On this occasion the bridge was covered with a closely packed crowd, particularly on the arch at the right bank, during the speeches of the official dignitaries. The crowd stepped back on to the sidewalks at the moment of the passing of the allied troops. The troops advanced across the bridge in step in two columns abreast and each column five men abreast. The two columns, marching in one direction, covered the entire length of the bridge for some considerable time, and really gave the best practical test of the work.

In spite of the marked increased cost of raw materials the cost of this work amounted to about \$9.30 per square foot, for the completed structure, including foundations, piers, abutment and the entire architectural treatment.

It is certain that the cost of this bridge could have been considerably diminished if the arches had been constructed of reinforced concrete, preserving the same architectural treatment. There are other bridges under construction for the city of Lyons which are entirely of reinforced concrete.

The Wilson Bridge is the work of M. C. Chalu-meau, City Engineer of Lyons, and the Hennebique Central Technical Bureau, 1 Rue Danton, Paris.

The information regarding the above work was supplied to us by F. G. Engholm & Partners, Excelsior Life Building, Toronto, the Canadian firm who have the sole rights of the Hennebique System of Reinforced Concrete Construction in Canada.

The Administrative Commissioners of Montreal have passed a by-law requiring buildings of three storeys and more to be equipped with fire escapes. This by-law is retroactive, and includes buildings used as offices, or used in whole or in part as a shop, factory, mill, warehouse, wholesale or departmental store, hotel, boarding house, theatre, concert hall, garage, church, school, seminary, college, convent, monastery, public or private hospital.

The Ebsary Fireproofing & Gypsum Block Co. have re-opened their Toronto office at 1009 C. P. R. Bldg. and are now prepared to fill orders for new business. Mr. F. S. Bridges will have charge.

The Toronto Housing Bill

Commission May Erect Moderately Priced Houses or Make Loans for Building Purposes—Houses Sold at Actual Cost

THE new housing bill of the City of Toronto, known as "The Toronto Housing Bill," was recently presented to the Board of Control and unanimously adopted. It will be sent to the government for ratification and immediately acted on by the Housing Commission, consisting of Sir J. Eaton, Sir James Woods, H. H. Williams, J. Allan Ross, and Frank Rolph.

The following is the Housing Act, as amended and adopted by the Board:—

Main Points in Act

Whereas the housing accommodation in the Municipality of the City of Toronto is insufficient to meet the needs of the inhabitants thereof; and whereas the Corporation of the said city has petitioned for an Act to empower it to acquire land and to erect dwelling houses to supply the said need and to authorize the municipality to borrow from time to time such moneys as it may require to meet the cost and expenses of the erection of such houses; and whereas it is expedient that the said work should be undertaken through a Commission; and whereas it is expedient to grant the prayer of the said petition;

Therefore His Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:—

1. This Act may be cited as "The Toronto Housing Act," and shall apply to the Municipality of the City of Toronto only.

2. In this Act—

(a) "Commission" shall mean the Housing Commission appointed by the Corporation for the purpose of this Act;

(b) "House" shall include all necessary improvements and conveniences;

(c) "Corporation" shall mean the Corporation of the City of Toronto.

3. The Corporation may from time to time borrow the full cost of the lands acquired and of the houses erected by the Commission under the provisions of this Act, and all moneys required to enable the Commission to make the loans provided for by Section 7 of this Act and payments on account of

such loans shall be made by the Corporation to the Commission from time to time during the progress of the work on estimates furnished by the Commission to the Corporation.

4. (1) The Corporation, for the purpose of this Act, may, without obtaining the assent of the electors, pass by-laws from time to time for borrowing on the general credit of the Corporation such moneys as the Commission may require and may agree with any bank, person or corporation for temporary advances upon such security as may be agreed upon and may issue Toronto Consolidated Loan Debentures for the payment of the moneys borrowed.

(2) Any money borrowed by the Corporation under the provision of this Act shall not be counted in ascertaining whether the limit of its borrowing powers has been reached under any general or special Act.

Provides for a Commission

5. (1) The Council of the Corporation shall by by-law forthwith appoint a Commission to be known as "The Toronto Housing Commission," for the purpose of carrying out the provisions of this Act.

(2) Such Commission shall be composed of five persons resident in the Municipality who are not members of the Council, and shall hold office for five years and until their successors are appointed.

(3) In case of a vacancy in the office of a member before the expiration of his term, the Council shall appoint a person to fill the vacancy for the unexpired term.

(4) The members of the Commission shall receive no salary or other remuneration and shall be eligible for re-appointment.

(5) The Commission shall elect a chairman and a vice-chairman, who shall preside at all meetings of the Commission in the absence of the chairman.

(6) The Commission shall be a body corporate and shall have a corporate seal, and all agreements of sale, conveyances and other documents shall be executed by the secretary and have the corporation seal attached thereto, but where by an oversight the seal has not been affixed it may be affixed at any time afterwards, and when so affixed the agreement of sale, conveyance or other document shall be as valid and effectual as if it had been originally sealed.

Functions of Commission

(7) The Commission may lease suitable premises for offices and may appoint and employ such officers, solicitors, assistants, clerks, servants and persons as it may deem necessary to carry out the objects and provisions of this Act, and may allow them such compensation or salaries as it deems fitting, and require and take from them such security for the due and faithful performance of their respective duties as it deems necessary; and the City Clerk, Commissioner of Works, Assessment Commissioner, the Assessors, the Treasurer, City Architect, and other officers of the Corporation shall, at the request of the Commission, and under direction of the Board of Control do and perform all such duties under this Act as they would do and perform for the Corporation in the like case if the carrying out of the provisions of this Act had been conferred on the Corporation.

(8) The money required by the Commission from time to time for the purposes of this Act shall be paid by the treasurer of the Corporation to the Commission on the certificate or order of the Commission, and

the Commission shall be responsible for the proper expenditure thereof.

(9) The treasurer shall keep separate accounts of all moneys borrowed by the corporation for the purposes of this Act.

6. The Commission may erect, on land acquired by it within the limits of the municipality, dwelling houses of not more than seven rooms of a class suitable for the accommodation of persons who have been on active service during the present war with the naval or military forces of Great Britain or her allies, and of working men and working women and men and women of moderate means who are residents of the City of Toronto.

7. (1) The Commission may make loans for the purposes of this Act on such terms and conditions as it may determine, except that the rate of interest charged shall not exceed the rate at which the corporation may be able to secure the moneys hereinbefore authorized to be borrowed, to—

(a) A private person who desires to erect a house for his own occupation on land owned by him;

(b) A private person who desires to erect a house for his own occupation on land owned by the Commission.

(2) All loans authorized by this Act shall be secured by first mortgage on real estate.

(3) The Commission may, if it thinks proper, require any person to furnish any security or make any payment or comply with any condition required by it.

8. (1) No loan made by the Commission shall be made upon any land or house not situate within the municipality.

(2) The person to whom a loan is made shall become a purchaser from the Commission under agreement of sale.

To Sell at Actual Cost

9. (1) Houses erected by the Commission may be sold by it to any person mentioned in Section 6 of this Act at such a price and on such terms as the Commission may determine, except that the rate of interest on any unpaid balance shall be in all cases computed at a rate not to exceed the rate at which the Corporation may secure borrowed moneys.

(2) The provisions of Section 48 of the Registry Act, as to the registration of mortgages endorsed "Not to be recorded in full," shall apply mutatis mutandis to agreements of sale under this Act.

10. All houses sold by the Commission shall be sold at actual cost as determined by the Commission, and in arriving at such cost the Commission shall be entitled to add to the actual cost of the land acquired and the buildings erected thereon all costs, charges, fees and other expenses incurred by the Commission in the carrying out of the provisions of this Act.

11. (1) The houses erected or purchased under the provisions of this Act shall not be sold, rented or leased, except with the written approval of the Commission, and any lease, agreement for lease, or for rent or sale made without such approval shall be null and void.

(2) This section shall not apply where the purchase money or the loan has been paid in full.

Defaults in Payment

12. (1) For the purpose of enforcing payment of the instalments due under any agreement of sale and of entering into possession after default, the Commission shall have all the remedies which a landlord has against a tenant under the Landlord and Tenant Act,

and the purchaser shall be deemed a tenant to the Commission.

(2) Where default has been made in any payment, or in any covenant or provision under an agreement of sale and the default continues for one month and the purchaser refuses to give up possession to the Commission, the Commission may by order authorize and require any constable, with such assistance as he may need, to enter on and take possession of the premises for and on behalf of the Commission.

13. (1) The Commission may acquire by purchase, or otherwise, or may without the consent of the owner enter upon and take land for the purposes of this Act.

(2) The compensation to be paid for any land taken shall be determined by a sole arbitrator who shall be one of the judges for the time being of the County Court of the County of York and in case the Commission and the owner of the land taken cannot agree upon such arbitrator, the Chief Justice of Ontario shall determine which County Judge shall be appointed.

(3) The arbitrator may determine the compensation to be paid for the land taken in a summary manner upon seven days' notice in writing to the person interested in the land, and after hearing what is alleged by all parties and without hearing any other evidence, unless the arbitrator decides to do so, and the award so made shall be final and binding and shall not be subject to appeal.

(4) The compensation to be paid for the land taken shall be the amount which the arbitrator determines is its fair market value, and nothing shall be allowed by reason of the land being available for the purposes of this Act, or for any increase in value by reason of the Commission contemplating the construction of houses on it or providing better means of access or transportation thereto, or by reason of the fact that the land is being taken.

(5) On determining the compensation to be paid, the arbitrator shall take into consideration the relative benefit or injury occasioned by the severance of the land of any person.

(6) The arbitrator may, if he thinks proper, retain the services of a valuator for the purpose of assisting in fixing the amount of the compensation.

(7) Except as otherwise herein provided, the provisions of The Municipal Act and the Municipal Arbitration Act as to expropriation and compensation shall mutatis mutandis apply.

Ban Against Aliens

14. No loan shall be made to any person, nor shall any house be sold to any person, nor shall any agreement of sale be assigned to any person, under the provisions of this Act, who is not a British subject.

15. The Corporation shall be responsible for and shall pay to the Commission the deficit, if any, of the Commission during the year.

16. The Commission shall, at the end of each calendar year, make a full and complete report to the Corporation of its operations during the year.

17. This Act shall come into force forthwith on the passing of it.

The proposed conference to be called by the National Federation of Construction Industries of the United States, tentatively arranged for May 7th and 8th, in Cleveland, is being postponed pending the action of the President of the United States in assembling a conference embracing all the business activities of the country.

Business Methods for the Building Contractor

By George A. Rutherford

IT has been said by someone that the three elements of business are labor, capital and management. I think it might be said also that the management in the building business is divided into two phases, namely, the supervision and the office administration. It is true that in late years a great many men have come into the field who are college men, and technically trained, and men trained in the offices of contractors. I think it also remains true that the great majority of contractors are men who served their apprenticeships in one of the principal parts of the building business, and who have come up from the position of journeyman to a foreman, then a superintendent, and afterwards they have gone into business for themselves. Those men have not had an opportunity to study business methods.

I do not think that the contractor has advanced as a business man to the extent that men in other lines like merchants and manufacturers have. I think that is largely due to the fact that the contractor has not had the advantages, possibly, which they have had.

It has been the idea that the contracting business was a gamble, and was very risky. It is not any more risky than any other business. It is simply a matter of knowing it, and when a proper system is used by a contractor, he can rest assured that he will go along just as well as men in any other line of business.

One of the principal things is the estimate. Of course, the estimate might have 50 or 60 sheets. On the first sheet of the one used in our office is the summary of the entire estimate. Of course, the heading is just the same as any contractor would use, with the owner's name, the designer and the location, and the estimate number, and listed by and "checked by," "dates," etc. This sheet shows:

- 1, General requirements; 2, job organization; 3, temporary construction and sheds; 4, plant and tools; 5, concrete plant; 6, clearing site; 7, excavation; 8, foundation work; 9, waterproofing and dampproofing; 10, concrete—plain; 11, reinforced concrete; 12, brick work and masonry; 13, stone and marble; 14, terra cotta; 15, interior marble and tile; 16, structural steel and iron; 17, ornamental iron; 18, carpentry; 19, metal doors and windows; 20, glass and glazing; 21, plumbing and sewers; 22, heating and ventilating; 23, plastering; 24, painting; 25, roofing; 26, sheet metal; 27, electrical work; 28, sprinklers; 29, elevators; 30, building equipment; 31, ground work.

Subdivisions

Now, taking up these first six headings as an illustration: They are all subdivided into other headings, and the estimator, in checking off his quantities and reading the specifications, checks items in the specifications; so that there is nothing under the heading that can be overlooked.

For instance, under "No. 1 General Requirements," we have these items:

Building permit, bond, fire insurance, liability in-

surancé, contractors' association, water, street permit, survey, contingencies.

No. 2 is "Job Organization and Expense," and under that heading comes:

Superintendent, timekeeper, engineer, watchman, telephone, cartage, cleaning up.

No. 3 "Temporary Construction and Sheds."

Our office, architect's office, cement shed, closet, fences and walks, roadways.

Under No. 4, "Plant and Tools," come:

Hoisting engines, hoisting tower, mortar mixer, scaffold plank, small tools, rope and tackle, water lines.

No. 5, Concrete Plant:

Mixer, hoisting engine, hoisting tower, chutes, charging plant, storage bins, carpenter shop.

No. 6, Clearing Site:

Removing old buildings, clearing site, shoring, adjacent buildings.

Brick Work and Masonry

Now, that is enough to illustrate these general headings. We will now take up "brick work and masonry," and under that title are these several heads:

Common brick, face brick, pattern brick, ground brick, fire brick, enamel brick, hollow brick, stack brick, special shapes, partition tile, packing tile, interlocking tile, gypsum block, fireproofing beams and columns, rubble masonry, backing up, toothing old walls, connecting present building, wall ties, setting lintels, setting hangers, outside scaffolds, coping, curbing, pointing, cleaning down, steps, boiler settings, flue linings, paving, chimney caps, safety treads, base, sidewalk lights, cleanout doors, chutes—coal and ash, furring, floor construction, flat arch construction.

Of course, all the headings are divided the same way, so that an estimator can hardly overlook an item if it is mentioned in the specifications. He must have some sort of a cost keeping system in order to arrive at the units to use, but, take brick work, for instance; it is not difficult: you know the cost of brick, the cost of the sand, the cost of the cement and lumber, and you know about what the labor ought to be on certain kinds of work; and those unit prices are figured out on another sheet.

When you have the unit price, it is only a matter of mathematics to figure the quantity and apply the rate; and that summary on each trade, of course, is carried out on the front.

Contingencies

Now, there are some jobs where you cannot anticipate all the things that may come up, where, for instance, it is difficult to work, or where the architect is very fussy and you do not know what he is going to want; so you must put in a "contingent" item for safety, just as the engineer puts in a factor of safety in computing his calculations on the building.

The first thing I made up my mind to do was that I was going to know what the cost of a job was, if I didn't know anything else; and I think the first job I did was putting up partitions under a big candy factory in Cleveland. I told the head bookkeeper at that time that I wanted to keep track of my work, and he gave me a form that they used in their business. Of course, he made some changes in it for me; but that is practically the same sheet that we have used ever since. That was in 1896, 22 years ago. I don't think this possibly would be the sheet I would keep the cost on for a large job if it were not for the fact we have

started to take care of small jobs. We have installed a job department and do lots of small work; and this same cost sheet will be applicable to a job of \$100 to \$150, because you can use just as many sheets as the job requires. We have the "heading," "work floor," "address," "location," "description of the work," and if it is a contract, the contract price is put in; or, if it is day work, the time it put in. There is a column for "extras." We make it a point to have a regular order for all costs and the amount of the cost and the date is put in there. So that when the job is completed, all that is necessary to do is to make a bill for the amount of the contract and amount of the extras.

Tabulating Orders

On the other side are the "order numbers," and as orders are made out for work on this job, the order number is put in, and before the job is footed up, they see to it that the order numbers are all checked off as having been invoiced.

The sheet shows the items as they come in. It is not necessary to itemize everything, but the invoice and the amount of it is put in there, so you have the cost of the material. There is room for some 20 or 22 men for 31 days; and, of course, you can use as many sheets as are required. If you have 100 men or 200 men you simply have that many more sheets, then we keep the different trades on different sheets, so as to put up the different trades separately for any purpose, the workmen's compensation particularly.

When our sheet is completed we have an itemized bill; if a contract, the contract price; and the extras; and before that is put away, the cost is put on and the selling price, and the gain and the percentage of gain. And then that is put away with all the records on the job, and we know just what we are doing on each job. If we do not show a gain, we have a little session and see what is the matter.

I want to say, too, that if the contractor gets into the habit of doing work that way, keeping track of things in that way, he will have a little more time to give his attention to the larger things than estimating. I do not believe the contractor ought to do estimating when his business gets to a point where he has something else to do, nor anything else. I find that after getting a system of this kind worked up, and getting an organization, I can go away to conventions and the job is going on just the same, and maybe better than if I were there.

The automobile road planned and already partly built by the city of Denver, Col., to connect with the heart of Mount Evans will be one of the most remarkable mountain highways in the world, says J. E. Murphy, in an illustrated article in the Popular Mechanics Magazine. With a mile high start at Denver, the road will wind through the titanic peaks and chasms of the roughest and most picturesque part of the Colorado Rockies, making a clear rise of 9,000 feet in 65 miles, and terminating on a summit that is higher than Pike's Peak. The road will be lighted by Gothic windows cut in the face of the cliff, a feature that is unusual in this country, although it has been used to a limited extent in Europe. This detour will be a trifle more than a mile in length. From end to end it will be a thoroughly practical automobile road 20 feet in width, with grades that nowhere exceed six feet in 100 feet. The entire project is estimated to cost about \$750,000.

Sixth Canadian Good Roads Congress and Exhibition, May 20-22

Parliament Buildings, Quebec City, Will be Location of This Year's Premier Canadian Good Roads Convention—Program is Given Below

TUESDAY, MAY 20th

Morning Session

Registration of delegates and visitors at Parliament Building. Registration continuing throughout the Congress.

Appointment of Nomination, Resolution and Legislation Committees.

Address of Welcome.

Afternoon Session

"Federal Aid," by Hon. J. D. Reid, Minister of Highways, Railways and Canals, Ottawa.

"Highway Maintenance," by Capt. J. A. Duchastel de Montrouge, C.E., Manager City of Outremont, P.Q.

"Gravel Roads," by Chas. Talbot, C.E., County Road Superintendent, London, Ont.

"Surface and Subsoil Drainage and Foundations," by Gabriel Henry, C.E., Chief Engineer, Province of Quebec Highways Department.

Annual dinner and entertainment at Chateau Frontenac in the evening.

WEDNESDAY, MAY 21st

Morning Session

"Roads as an Aid to Agriculture." Address by Hon. Geo. S. Henry, Minister of Agriculture, Province of Ontario, and Hon. J. A. Caron, Minister of Agriculture of Quebec.

"Hot Mix Asphalt Pavements," by Francis P. Smith, Ph.D., Consulting Engineer, New York City.

"Practical Advice to Road Superintendents and Municipal Councils," by Alexandre Fraser, C.E., Assistant Chief Engineer, Province of Quebec, Highways Department.

"Bituminous Macadam." (Penetration Method) by A. W. Dean, Chief Engineer, Massachusetts Highway Commission.

Annual Meeting, Canadian Automobile Association, at Chateau Frontenac.

Afternoon Session

"Shall We Restrict the Load or Build the Road?" by W. A. McLean, Deputy Minister of Highways, Province of Ontario.

"Concrete in Road Construction, Culverts

and Bridges," by Eltinge G. Breed, Chief Engineer, New York State Highways Department, Albany, N.Y.

"Construction and Maintenance of Macadamized Gravel Roads," by Alex. Lariviere, C.E., Engineer, Province of Quebec, Highways Department.

"The Use of Refined Tar in Construction and Maintenance," by Paul D. Sargent, Chief Engineer, Maine Highways Commission, Augusta, Me.

Evening Session

Annual general meeting, Canadian Good Roads Association for election of directors and officers, and reception of annual report and financial and other reports.

THURSDAY, MAY 22nd

Morning Session

"Schools for Highway Engineering," by Prof. A. T. Laing, University of Toronto, Ontario.

"Drainage," by Jas. H. McDonald, Consulting Engineer, New Haven, Conn.

"Construction and Maintenance of Macadamized Municipal Roads," by A. Paradis, C.E., Engineer, Province of Quebec, Highways Department.

"Macadam Roads," by A. P. Sandles, Secretary, National Crushed Stone Association, Columbus, Ohio.

Luncheon and drive at noon.

Afternoon Session

"Keeping the Highways Open in Winter," by Hon. Frank Carrel, Quebec.

"Road Machinery," by Prof. A. H. Blanchard, Consulting Engineer, New York City.

"A Comparative Study of the Different Methods of Transportation of Road Materials," by E. W. Gauvreau, C.E., Engineer, Province of Quebec, Highways Department.

"Contracts, the Contractor and Labor vs. Government Construction of Trunk or Main Roads," by Col. W. D. Sohier, Chairman, Massachusetts Highway Commission, Boston, Mass.

Methods of Highway Maintenance

Specific Upkeep Programmes Outlined in Paper Read Before American Road Builders' Association—Road Machine Not a Cure-All

By Frederic E. Everett*

IN the creation of highway systems as a general thing all energies are devoted to the layout and construction of a continuous line of highway, and the maintenance of such roads has been a secondary matter, and it is only after the constructed highway has reached the stage where re-surfacing is necessary that the people wake up to the fact that maintenance should have been the all important factor from the moment that construction ceased. Especially was this true with states that began construction twenty, fifteen or even ten years ago. The type of traffic was entirely different then than now, and any type of hard surface road, properly drained, was considered as permanent construction, and anything permanently constructed certainly would not need maintenance.

My own state of New Hampshire affords a good example of just that sort of thing. We began to build state aid roads in 1905 with no maintenance law outside of this one clause: "The towns shall maintain the roads constructed by the joint state and town funds." We continued to build roads at the rate of practically one hundred miles per year, until 1911, the towns doing what maintenance was done, but in most cases, doing nothing, with the result that when the maintenance law was passed, in 1911, making available the motor vehicle fees, we had a considerable mileage of state aid road that required rebuilding, and in the eight years that we have had a maintenance system we have never been quite able to catch up with our rebuilding programme.

Maintenance Programme

This condition obtained in practically all states that began their construction programme in the nineties, or the beginning of the present century, and it is only in those states that have organized highway departments in the last few years that a maintenance programme has been outlined as the outset. Therefore, if maintenance of a constructed road was not provided for, certainly the uncompleted sections of a designated system of trunk lines or main highways would receive but scant attention as far as the state was concerned. Further, the fact that such a highway or highways were designated for future state construction would be a sufficient reason why the town or county should not expend any money in repairing a road that was to be newly constructed sometime in the future. The result is that in many states the unconstructed sections of designated trunk line systems are the poorest roads to be found in those states. The methods of maintenance, if left to the town or county, as a general thing consist in doing as little as possible.

In my own state the county, as a unit, is not considered in matters of road construction or maintenance, except in unincorporated towns. There are no county roads except in a few isolated cases, the towns being charged with the maintenance of all roads not

cared for by the state, and to within a comparatively few years it might be said that there were as many systems of maintenance as there were towns or, in other words, there was no system.

Abuse of the Road Machine

Each town road agent or district surveyor had his own ideas as to the up-keep of highways and, as in a good many cases, he only served one year. He proceeded to carry into practice whatever theory he may have developed from observation or reading the weekly newspaper. One idea that seemed to be common, however, was that the road machine was a cure-all for any road disease, and that all roads should have at least one dose of it every season. This useful, but very much abused article was, therefore, teamed up with from six to eight horses, with the road agent majestically stationed behind the manipulating levers in the rear, the roads from one end of the town to the other were treated. The machine dragged in stone, roots, mud, sods and worn-out road material, which was levelled by men and boys equipped with garden rakes and hoes, great care being used not to remove any sods or material of that nature. After such treatment, for weeks and sometimes months, it would be unsafe for a team to travel this road faster than a walk.

But as the maintenance and care of state roads came into existence, the methods of maintaining town roads began to improve and many towns began to apply the patrol system which was giving such satisfactory results on the state roads, to their town roads and with good effect.

Patrol Maintenance

There is a provision in our statutes at the present time that any town may at its annual town meeting set aside any part of its town highway system for patrol maintenance, under the supervision and inspection of the State Highway Department. The towns, however, have to pay the whole expense of such maintenance as there are no state funds available for such work. The cost varies from \$50 to \$150 per mile. A number of towns throughout the state are availing themselves of this law and good results are being obtained.

In 1915 the department designated for future improvement twelve new cross-state lines in addition to our trunk line system. As there would be no funds available for construction for at least two years, it was decided to band the new system with our designating color bands, and to assist the towns in getting them under the patrol system. Our method was to get the town to put the road in as good condition as possible by removing stones, cutting the brush, machining in a safe and sane way, removing the sods and worn-out material. Then the state would pay at least one-half of the patrolling.

The unimproved sections showed a wonderful improvement in a year's time, but unfortunately our maintenance funds were not sufficient to stand the ex-

*Commissioner of Highways of New Hampshire.

tra expense of this work and the plan had to be abandoned in so far as the state participating in the expense. Many towns, however, are continuing the method, believing that they get more for their money than they did under the old form of maintenance.

Lack of Funds

I find that the greater number of states are, either in the same situation as New Hampshire, that is, having no funds available for such work or else have not as yet any outlined plan of maintaining unimproved designated systems, whereas certain other states have done a great deal along this line. I am going to outline briefly some of the methods that have been adopted by states which have been brought to my personal attention.

In Kansas the highways are divided between the county and township, the proportion of county road being based upon the assessed valuation and the total mileage of public roads. The maintenance of these roads consists mainly of grading with the ordinary blade grader, filling depressions, cutting down hills, and then dragging by patrol system.

The Commonwealth of Virginia during the last year has designated a state highway system and they are maintaining sections of this system which were built of sand-clay and soil with a minimum width of twenty feet between ditches and the maximum grade of five per cent. In taking care of this maintenance they have decided on an organization of a foreman and three teams, together with road machine, wagon, split-log drags and from three to six laborers. This force during the time from December to April will look after the removing of snow, dragging and repairing holes on sections of road from thirty to forty-five miles long. After April two or more of these forces will be used in doing heavy repair work and from four to six of these forces will be placed under one superintendent, who will have charge of from one hundred and twenty to two hundred miles of road. Mr. Coleman, Highway Commissioner of Virginia, says that the method of maintaining earth roads prior to improvement by state or county, as used by various counties, is very varied. The amount spent by counties on such roads will vary from \$2.50 to possibly \$25.00 per mile per year.

Usually the roads of the various magisterial districts of a county averaging about 500 miles will be put in charge of a road foreman, who will go over as many of the roads as possible between April 1st and November 1st, ditching with road machine, opening wooden box drains and crowning the road.

Farmers' Repair Work Not Satisfactory

Repairs to the road surface when this force is not available, or during the winter months, is usually done by farmers living along the road. However, the results are usually anything but satisfactory.

Wisconsin has recently laid out and designated five thousand miles of trunk highways and placed them under patrol. The system is divided into four hundred and eighty patrol sections, varying from six to twenty miles in length. The average section for an earth road in average condition should be seven miles.

The patrolmen are paid from \$120 to \$135 per month, and are required to furnish a good team and wagon, the county furnishing the remainder of the tools. They are required to sign a contract and give a bond for \$500. The patrolmen are instructed in county

road schools conducted by the division engineers and county highway commissioners.

In addition to the patrol each county does a certain amount of gang maintenance, including heavy road machine grading, scarifying, light resurfacing, etc. The cost for this work for 1918 amounted to \$125 per mile, and the patrolling about the same.

Mr. Hirst, the state highway engineer of Wisconsin, states that in one year's time the average condition of the five thousand miles of trunk highway have been improved at least 50 per cent., and that in one year the increased number of miles per hour which can be safely averaged by autos over the state trunk highways is seven. This is certainly some improvement from the traveller's standpoint.

The State of Maine has approximately seven hundred and eight miles of unimproved designated state highway under patrol maintenance. Together with the unimproved roads each patrolman has more or less improved road to take care of. In the spring each town having any mileage of unimproved state highway is asked to set aside \$50 for road machine work and the state puts in a like amount.

Road Machine Work

The road machine work consists of light smoothing, cutting off the shoulders and shaping the road before the patrolman begins his work, the main idea being to improve the crown of the road, clean out old ditches and make new ones and improve the surface drainage. Maine has a patrol maintenance law, whereby they assess the towns a certain amount per mile. This cannot be less than \$30 or more than \$60 per mile. The state apportionment varies from year to year, according to the amount available. There is no special apportionment on unimproved mileage, except the \$50 for machine work. The patrolmen take care of their sections by dragging, hauling material, filling depressions, keeping the road from rocks and the ditches and culverts open. There are not sufficient funds to repair culverts or plank bridges, the towns having to do that sort of work. The patrolmen may assist in the labor when it does not require more than a day or so at a time. Patrolmen and supervisors are instructed that the smoothing of the road with either drag or two horse grader must not be neglected but should receive the first consideration.

Mr. Sargent, the chief engineer of the Maine Highway Commission, says that it is possible to improve only a small mileage of designated state highway each year. They, therefore, in 1916, undertook the patrol maintenance of these unimproved sections in order to give the travelling public the best possible conditions with the money available. The results have been satisfactory, conditions have been much improved in three years, and, as every one knows, under an increased traffic.

I have given a brief outline of what a few of the states are doing in the way of maintenance of unimproved designated highway systems. I have no doubt that a number of other states are doing as much or more along this line. It would seem, however, in drawing some conclusion from the experience of these few states I have referred to, that the maintenance of designated highway systems prior to construction by state or county should be under state supervision, and that the most efficient method would be a combination of gang and patrol maintenance, the expense of which to be borne in part, if not wholly, by the state.

Maintenance and Painting of Highway Bridges

NO maintenance of bridges will be as effective as maintenance applied regularly each year and the necessary repairs determined by periodical inspection of the structures. Every structure, concrete, steel, wood or pipe, should be inspected at least once every year and a detailed report made upon their condition. More frequent inspections should be made of structures in a bad state of repair, while small culverts should be inspected after every hard rain. By such a system repairs can be made where and when needed. The cost of repairs will not be allowed to accumulate nor will the structure be allowed to suffer from the lack of repairs.

Classification of Structures According to Structural Conditions.

I will explain what I should do with the funds you may have available were I county road engineer in your county, and will try to suggest something helpful which may be done by everyone and which must be done if existing structures are to be preserved in suitable condition for traffic.

First—A complete inspection would be made as heretofore suggested and a complete report made of every existing structure within the county.

Second—The structures would then be subdivided into three classes: (A) Structures needing no repair or maintenance, (B) structures which must be rebuilt immediately, (C) structures which may be repaired or strengthened.

Third—The classes noted under (B) and (C) would again be subdivided, the class noted under (B) under three subheads as follows:

1. Structures which must be permanently renewed both the substructures and superstructures.
2. Structures in which the substructure only shall be renewed permanently and a temporary superstructure built thereon.
3. Structures in which the substructures are serviceable and require a permanent superstructure.

The bridges noted under (C) would be subdivided as follows:

1. Bridges requiring strengthening to trusses and floor systems.
2. Bridges requiring no strengthening but new floors.
3. Bridges requiring only painting.
4. Bridges requiring painting and repairs to floor.
5. Bridges requiring complete repainting and new floors.
6. Bridges requiring repairs to the substructures.

Value of Classification

What would be the value of such a complex system of dividing and subdividing? There are many things it would show quickly. First, it would give a complete list of structures in your county with a classification which would allow the only correct distribution of the bridge fund. Second, it would show your court what was necessary on every bridge in the county during the coming year. Third, it would quickly afford a basis for estimating the money necessary for this maintenance and construction during the year and would be in such a form that it would appeal to every busi-

ness man in the county because he would know you had investigated conditions. Fourth, it would emphasize the want of funds for this work. Fifth, it would outline this work for your men in advance for the year in every district and eliminate bringing the forces back and forth as these conditions were discovered or reported.

Having completed the report and an estimate of the cost of the work, it should be published in every newspaper within the county with a statement of the funds available and your policy for expending such funds in each district. Everyone would then see that the money had been allotted where needed. This is the only reason for a common pool of the county's funds in the county treasury, and the only equitable way of spending money raised by taxation.

Strengthening and Repairing Old Bridges

Only class (C) structures will be discussed under maintenance. These are bridges which are to be strengthened, painted, refloored, or upon which work is required on the substructure. This work through necessity must be handled both by force account and by contract and it is well that we consider the most important features of such work, namely, strengthening old bridges, reflooring and repainting.

The old wooden trusses if too light for modern traffic do not offer much opportunity for strengthening at an economical cost. These trusses should be temporarily repaired and their floor systems brought up to the maximum capacities of the trusses. These bridges should be posted with signs warning the traveling public against overloading. The maximum allowable load should be clearly stated on the sign. It is possible that the floor systems can be increased by increasing the number of the floor beams and stringers, or else by increasing the size of floor beams and stringers. This can be economically done at a time when the floor has been removed for stringer repair or reflooring.

Many of the light steel truss bridges can be strengthened by changing the sizes of floor beams and increasing the number of stringers so that they may be made to carry safely double or perhaps three times the present wagon or truck loading. It may be necessary to make changes in connections and in certain web members to increase the capacity, but it can be done far cheaper than rebuilding in many cases. It is far cheaper to spend a few dollars in strengthening than to allow structures to be daily overloaded and their cost of maintenance to soar. There is a certain bridge I have in mind in which it is impossible to keep the floor nailed down in place due to the fact that the stringers and floor beams deflect so greatly under the heavy loads that they pull the nails.

There is a suggestion too with regard to strengthening bridges which may be accomplished with little additional expenditure. It is more important to be able to get your loads over a structure than it is to save time getting them over. It is possible in some cases to reduce both the dead load on a structure and to confine the moving load to the centre of the bridge and thus carry over with safety greater loads. This can be accomplished by reducing the width of travel way of the bridge. The proper fences and guard rails must be installed to prevent accident or traffic from using the remainder of the structure.

Bridge Floors

The day when bridge floors 2½ in. to 3 in. thick-

ness can be economically used for modern traffic has passed. For heavy traffic the maximum span for 4-in. flooring should be about 27 in. This span can be somewhat increased for loads of 10 tons or less, or 3-in. floor used when the spacing of stringers does not exceed 24 in. Investigation of your bridge floors will show that few of them remain long enough for decay to destroy, but instead traffic wears them out. In replacing wooden floors, if the span is not strong enough and cannot be economically strengthened to carry a better type of floor, it is to be recommended that a 2-in. x 4-in. wooden floor be used, the lumber being laid on edge and all contact surfaces thoroughly swabbed with hot tar and cambered to shed water. This type of floor has been extensively employed on new structures and is giving complete satisfaction. I have just recently had occasion to inspect such a floor which had been down for a period of nearly 6 years and it showed no signs of decay or wear, yet it was subjected daily to a large volume of heavy traffic, both horse and motor drawn. The cost of this type of floor is about 50 ct. per square foot of floor surface. In laying this type of floor on old truss bridges whose stringers in the end panels merely rest on the concrete or masonry, it will be necessary to anchor at least the outside stringers to the masonry or else the floor will lift these stringers. About 1 bbl. of tar is required for every 30 ft. of length if the bridge has a 16-ft. roadway.

Painting

Where the paint shows signs of deadness or rust has begun on the steel, these portions at least of a steel bridge should be thoroughly cleaned and repainted with red lead paint. It is not always necessary to repaint a bridge throughout and it is a poor policy to allow a portion of the structure to rust because the whole does not need repainting. This protection of your steel where needed may save repainting the entire structure for several years.

When a bridge is to be repainted, the steel must be thoroughly cleaned of rust, dirt, grease and dead paint. Too much emphasis cannot be laid upon the necessity of a thorough cleaning. A span may be cleaned by scraping, brushing with a wire brush, burning off the dead paint with a torch and then scraping or by a sand blast. The sand blast is the most efficient method of cleaning.

When it is necessary to repaint a bridge entirely and thoroughly clean it; red lead next to the metal itself is recommended. The red lead if in paste form, should be mixed with boiled linseed oil in the field, about 18 lb. of red lead to 1 gal. of oil. After this coat of paint has thoroughly dried an additional coat of paint should be applied. For the additional coats of paint, some light colored paint is recommended because it betrays the presence of rust; harmonizes with the substructure and makes highway bridges readily visible at night. This paint should be mixed in about the same proportion by weight to the gallon of oil if mixed in the field as specified above for red lead. The cost of the paint itself is comparatively small to the cost of labor applying it and to the cost of cleaning the structure. Only the very best paints should be used.

Paint to be effective must be elastic, must retard and prevent as far as possible rust; it must be a non-conductor of electricity and must be insoluble in water or else it will break down and disintegrate. Moisture cannot be excluded between the steel and paint, if paint is applied during wet or freezing weather. The

second coat of paint must never be put on until the first coat has thoroughly dried.

[The above article was prepared by Chas. D. Snead, bridge engineer, Kentucky Department of Public Roads for presentation to the Road School, University of Kentucky.]

Dry Feeding of Chemicals Used in Water Purification

IN the design and operation of filtration plants one of the most important features is the method of applying the coagulant to the water to be treated.

Since the inception of mechanical filtration, the making of solutions and the application of the solutions to the water has been the generally accepted plan of treatment. The use of solutions has always been attended with more or less difficulty, due primarily to the fact that in order to avoid the extreme cost of large solution tanks that would be necessary to make up dilute solutions, the practice has been to use solutions of considerable strength and in consequence of a highly corrosive nature, with a consequent rapid deterioration of all materials which it came in contact with. Pumps were used largely in the earlier days, to pump the solutions from tanks that were located below the floor line of the building, in order to avoid taking up valuable and costly space in building construction.

Present Practice

However, the cost of maintenance of pumping apparatus and piping connections proving so excessive, the latter-day practice has been the elevation of solution tanks into upper parts of the building and then feeding by gravity through constant head orifice tanks, using as short line connections as possible to reduce to the minimum the depreciation cost.

This, however, has meant a very considerable increase in the cost of building construction, due to the necessary supports of tanks and the considerable space occupied by the solution tanks. It has been recognized for many years that a satisfactory method of measuring and feeding pulverized materials that would avoid the use of solution tanks, and simplify and reduce the quantity of piping necessary, was the ultimate ideal solution of this vexatious question.

A number of different devices have from time to time been used with more or less success, but there has, so far, evidently been lacking some essential detail necessary to their successful operation and extensive use.

The city of St. Louis has been using a dry-feed process for a considerable number of years. The apparatus, however, is an extremely elaborate and expensive proposition, beyond the reach of most large plants and utterly out of consideration for the average plant.

A New Machine Developed for Dry Feeding

One filter manufacturing company has been experimenting with a number of different devices and designs and have finally developed a machine that will meet the popular need and be low enough in cost to come into general use. This machine, after being constructed, was given a considerable test in the shop, and one of the machines was then placed in operation

in the city of Toledo filtration plant, where it has been operating continuously dry and night for over two and one-half years. It has required practically no attention and has given no serious difficulty, while the results in the treatment of the water, or the application of the chemicals, has shown a more uniform treatment than by the old solution method originally used. Since then these machines have been installed for the use of pulverized alum, iron, soda ash and lime, with most gratifying results.

Dry Feeding Installations

In the construction of the 12,000,000-gal. plant at Great Falls, Mont., solution tanks were entirely omitted from the design, and the chemical feed provided for entirely by the installation of three of these dry-feed machines, set in a battery. These three machines with their hoppers occupy about one-half of the space that would have been required for one solution tank, while in order to provide for continuous feeding of solution two solution tanks would have been required for each chemical used. The saving, therefore, in the construction cost at this plant has paid for the dry-feed installation several times over in the initial cost.

The city of Flint, Mich., increased the capacity of their filtration plant from 8 to 16,000,000 gals. per day, abandoned the solution tanks and installed this system of dry feeding of chemicals. By the system to be installed there the pulverized chemicals will be unloaded into bins located over the dry-feed machines, and after the one handling of the material from the car to the bin the entire operation is by gravity into the daily hopper of the machine and from there to the solution mixing chambers. In addition to the economy in installation there is the added economy in the operation due to the single handling of the material that cannot be avoided where solutions are necessary to be made in the ordinary way.

Description of the Machine

The machine is simple in form, readily accessible in all parts, has comparatively little to wear, and that easily replaceable. It is subject to a wide variation in range of feeding, from 150 lbs. per 24 hours up to 15,000 lbs. per 24 hours. It is an accurate feed through all stages of this range.

It consists of a main cast iron housing, into which is fitted a roughened drum wheel, upon which the material rests and which carries the material forward through an adjustable orifice. The degree of opening and therefore the rate of feed is indicated by a pointer on one side of the frame of the machine. This feed wheel is operated by a ratchet wheel attached to the same shaft and on the outside of the framework. The ratchet in turn is operated by a motor.

Adjusting the Feed

There are three means of adjusting the feed to the required amount. First, by the orifice opening; second, by the adjustment of the ratchet to the number of teeth that the pawl engages at each stroke; third, by the speed of the motor. This gives an extremely wide range of adjustment. One side of the machine is open, or rather the removal of all the internal working parts of the machine, without the necessity of taking it apart or from its location. Each machine is operated by an absolute displacement piston motor mounted on the same frame with the machine. This motor may be arranged to operate at any given num-

ber of strokes per minute that is desired, and by the use of proper controlling device in conjunction with the Venturi tube can be arranged to operate proportionately to the flow of water that it is desired to treat. With each machine is furnished a cast iron mixing box or chamber, into which the dry material is discharged. This is a cast iron box with removable baffles, to enable the convenient cleaning of any sediment that may accumulate in the bottom.

Regulating Strength of Solution

Water for dissolving is introduced into a mixing chamber immediately below the point at which the dry material is discharged into the mixing chamber, and can be introduced in any quantity or portion desired. In other words, the solution may be made as weak as desirable to avoid the corrosive action of the solution on the piping system used to carry the solution to the final entrance to the water to be treated.

By this arrangement materials can be used for this work that, with the ordinary strength of solution necessary when solution tanks are employed, would be impossible by reason of the corrosive action.

New President of Canadian Manufacturers Association



Thomas Palmer Howard, managing director of the Phoenix Bridge and Iron Works, will be the new President of the Canadian Manufacturers' Association.

Bids for Spadina Road Sewer, Toronto

The following list of bids was received for the proposed 12-inch water main on Spadina Road, part of the waterworks system for York Township, Ont., designed by Frank Barber and R. O. Wynne-Roberts, Toronto:

Murphy Contracting Co.	\$ 6,618.66
A. J. Panting & Co.	6,736.20
Mitchell & Mohan	7,221.01
Angelo Cavotti	7,624.13
J. H. McKnight Construction Co.	7,702.95
Perluisi & King	13,917.25
Grant Constructing Co., ...	7,398.54
Grant, Jack	7,813.60

Portable Scoop Conveyors Secure Economical Handling of Materials

TO secure economical operation and greater efficiency in handling material, labor must be supplanted by machines and these selected which are best adapted for the particular work. Men with wheelbarrows are too costly to use in storing, moving or loading material, but, at the same time, the old style conveyors required a great deal of labor in shovelling the material up into the receiving hoppers.

A new type of portable conveyor, which cuts the labor of feeding one-half, is shown in the accompanying illustrations. The most distinctive feature of this machine, called the scoop conveyor, is the scoop on the feeding end, which can be pushed or completely buried into the material to be conveyed. This makes it possible to simply scrape the material on the carrying belt, instead of lifting it up by shovelfuls into the feeding hoppers of ordinary conveyors.

Another exclusive feature of this machine is the construction of the sides or skirt plates as they are called. These form a trough which enables a 12-inch wide belt to equal in carrying capacity a 20-inch ordinary troughed belt. This is readily understood when one remembers that on a troughed belt, the material is carried in the centre or trough, that on the sides falling into the trough or rolling back, whereas, the side plates on the scoop conveyor hold the material together, giving the whole width of the belt carrying effectiveness. It is due to the skirt plates, also, that a 24 ft. long scoop conveyor will convey material as high as a 30 ft. troughed belt. The resultant saving in belt expense is considerable, as two new 12 inch x 24 ft. scoop conveyor belts can be purchased for the price of one 20 inch x 30 ft. troughed conveyor belt.

While the scoop conveyor has been on the market only a short time, the manufacturers state that there are now over 1,000 in use and that they are receiving over 50 per cent. repeat orders. This would seem to indicate that the machines are giving good satisfaction to their owners.

Saving in Expense and Labor

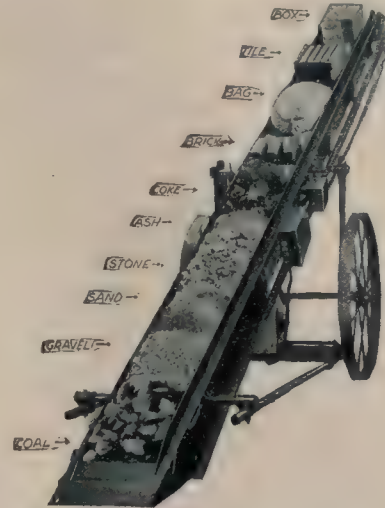
The money savings resulting from the use of a scoop conveyor are due, first, to the saving in labor, second, to the speed at which material is conveyed. In comparison with handling material by hand, one or two men with a scoop conveyor will do the same work as from four to twelve men, depending upon conditions. The scoop conveyor will load trucks in one-fourth to one sixth the time required by men

shovelling. It often enables one truck to do the work of two trucks and of getting two days' work done in one day.

Storage capacity is another factor of saving attributed to this machine, as it increases the available capacity of a shed or yard space by enabling the men to pile higher.

Capacity and Uses

The carrying capacity of the scoop conveyor, based on handling coal, is one ton per minute, provided a sufficient amount of coal is maintained at the receiving end of the machine. If the storage pile is of sufficient height, one man can easily feed one ton in one



This portable conveyor is readily adaptable to all varieties of materials

and a half minutes, or if the pile is low, he may require from two to four minutes. Where speed is required two men may be provided for feeding. In unloading hopper bottom cars the machine and one man can remove one ton per minute.

Large size coal, coke, crushed stone, etc., fed by one man require from three to six minutes for one ton or half that time with two men.

The scoop conveyor is used principally for storing, reclaiming and loading bulk material and light articles. There are an unlimited number of uses for the machine, in addition, such as elevating material to tanks or platforms in chemical and industrial works, feeding from cars and delivering into fixed conveyors or stoker magazines at power plants, etc. Almost any kind of material can be handled, such as coal of all kinds, ashes, sand, earth, crushed stone, blast furnace slag,



Portable scoop conveyors reduce expense of handling materials from cars or piles to bins or wagons

ore, fertilizer, salt, chemicals, grain, bags and light packages.

The scoop conveyor may be used singly, in tandem or in triplicate as may be required. The employment of sets of two or more allows for an increase in height of the storage pile or conveying distance.

Construction

The scoop conveyor is strongly constructed, light in weight, compact and portable. The steel frame holding the rollers and conveying belt is mounted on the wheels so the balance is perfect. One man, by inserting the pipe handles into the ends of the horizontal members, can easily lift and move the machine around.

The electric motor or gasoline engine mounted under the frame transmits power to the conveyor by means of a chain and sprocket connection to a shaft extending beneath the conveyor. From a sprocket on the other end of this shaft the power, in turn, is transmitted to the driving sprocket, located at the upper end of the conveyor.

The carrying belt is a high grade of heavy duck and rubber conveying belt and duck cross strips. These transverse cleats are provided to prevent the material from slipping back down the incline.

The scoop conveyor is made in three different sizes 13 ft. 8 in., 19 ft. 8 in., and 24 ft. The width of the conveying belt on any of these sizes may be either 12 in. or 16 in. wide as desired. Size 13 ft. 8 in. elevates to a total height from the ground of 5 ft. 9 in., the 19 ft. 8 in. size may be adjusted for any height from 6 feet to 9 feet, and the 24 ft. size may be adjusted for any height from 9 feet to 12 feet. The machines are furnished with either electric motor or gasoline engine, or where customer prefers to furnish and install motor himself, motor support and drive from motor shaft are provided.

Scoop conveyors are manufactured by The Portable Machinery Co., Inc., Passaic, N.J.

Snow Removal From Roads Found to Decrease Repair Cost in Spring by One-third

THE necessity for the removal of snow from many highways has been recognized in a small way for many years. The increase in motor traffic has caused more emphasis to be placed on the matter, and many highway departments have been taking measures to keep their roads passable during the winter months. A report given at the American Road Builders' Association, which we reprint herewith, describes Connecticut's methods of handling the snow problem.

As early as the winter of 1916 plans were made by the State Highway Department to experiment on the removal of snow from the most important trunk lines. These plans originated for two reasons; one, the increasing truck traffic and the other, the disastrous results of this traffic when confined to one or two sets of ruts, due to the accumulation of snow and ice. Under these conditions ruts were worn into the surface which were very expensive and difficult to repair, and could not be removed entirely.

Removal of Snow Reduces Repair Expense

Experiments carried on during the winter of 1917 showed that the formation of these ruts was practically prevented by the removal of snow, decreasing the cost of bituminous repairs the following spring

by at least one third. Traffic on these roads during the winter months showed only a slight decrease in the normal use of auto trucks. Such good results were obtained that the legislature of 1917 passed the following act, obligating the State Highway Department to remove snow from trunk line highways:

"Section 1. The highway commissioner shall cause the removal of snow from any completed portion of any trunk line highway when the accumulation thereof shall render such highway unsafe or impassable for the public travel. He may direct the selectmen of any town or officer having charge of such highways in any municipality to remove such accumulation of snow at the expense of the state.

Section 2. Nothing in this act shall relieve the responsibility of street railway companies for the proper removal of snow from their track areas and without the obstruction of the traveled path of the trunk line highways."

To carry out this work the department planned to use eighteen snow plows attached to the front of its trucks. Due to the severest winter conditions known for twenty years these proved inadequate, and tractors and road-machines of all kinds were used. The snow plow equipment is being increased by the addition of twenty more plows for use on the front of the trucks.

The work was successful. At no time were any of the trunk lines blocked for more than twenty hours and usually normal traffic conditions were obtained the morning following the end of the storm.

On routes heavily travelled by trucks practically all the snow was removed, while on roads with a mixed traffic the snow was removed so that not more than three inches remained.

Some complaints were received on account of the inability to haul by sleds, but the necessity for the moving of great quantities of war and industrial materials, which could not be moved except by auto truck, fully justified this procedure and the expense involved. Figures as to the cost of the work are of little value on account of the varying nature of the country and density and amount of snow fall.

The total cost of the work for 1917 was about \$40,350.00 on a total of 970 miles. Including the cost of equipment the rate per mile would be about \$45.00. Under normal conditions of snowfall this figure would probably not reach \$30.00 per mile.

Work was started either day or night whenever snow had accumulated to a depth of over five inches, whether the storm was over or only just going good. It is probably the most disagreeable of all highway work, but was taken care of by the ordinary forces with fine spirit.

The H. C. Johnston Co., Limited, contracting engineers, have opened an office at 701-2 Bank of Toronto Building, Montreal. Mr. Johnston was formerly with Anglins, Ltd.

Trade Publication

"Over 1,000 Scoop Conveyors" is the title of a 20-page folder just published by the Portable Machinery Co., Passaic, N.J. This folder, with illustrations showing the various uses of the scoop conveyor, describes the labor, time and money-saving features of the machine in storing, reclaiming, loading and unloading material such as coal, coke, ashes, sand, gravel, crushed stone, fertilizer, cement, chemicals, etc.

Mainly Constructional

East and West—From Coast to Coast

The St. Boniface city council has directed the city engineer to place his orders for materials of any kind with local firms.

The bricklayers' strike in Regina, Sask., has been settled. The terms of the agreement are not to hand at the time of going to press.

It is reported that the C.P.R. propose electrifying their branch line from Three Rivers to Shawinigan Falls and Grand Mere, P.Q.

Quebec City's building permits for the month of April amounted to a value of \$270,125, as compared with \$109,044 for the corresponding month in 1918.

Ingersoll, Ont., is the first town to let contracts under the government housing scheme. Fifty houses are to be constructed near the centre of the town.

A housing committee has been formed at Elmira, Ont., under the provisions of the Ontario Housing Act, consisting of Messrs. Wm. Anman, I. Groff and P. F. Stumpf.

Building permits issued in Windsor, Ont., during April number 71, and are valued at \$119,440, as compared with 50 permits valued at \$91,000, the same month last year.

The Ottawa Board of Control has authorized the city housing commission to appoint a secretary and establish an office and has made a grant of \$4,000 towards its work.

Building permits issued in Guelph, Ont., for the month of April number 24, and are valued at \$53,385. This is the largest total reached in any month for a considerable time.

The total of the building permits issued in Brantford, Ont., for the first four months of the year is 99, at a value of \$159,085, an increase of \$100,000 over the corresponding period last year.

The plumbers in Moose Jaw, Sask., who were demanding an increase from 70 cents an hour to 85 cents an hour, have settled with the employers for 80 cents an hour and an eight-hour day.

Commissioner L. A. Thornton, of Regina, states that in the near future the city will have to spend at least \$60,000 in replacing the wooden water pipe in the business district, with cast iron or steel pipe.

There have been 207 building permits issued in the Township of York during the month of April, valued at \$294,000. These include 122 dwellings, 82 additions and alterations, six stores and an apartment house.

The master plumbers of Regina, Sask., have settled with the journeymen plumbers, granting them a fifteen per cent. increase in wages. A corresponding increase in plumbing charges to householders will immediately result.

The civic strike in Brandon, Man., was settled on the terms that the men's union should be recognized, that an arbitration board should be formed and that certain employees who were dismissed should be reinstated.

The Army and Navy Veterans' Association in Winnipeg recently sent a delegation to Premier Norris to urge the necessity of the provincial government building houses and so relieve the present situation which is causing some difficulty to returned men.

The demands of the masons of Fredericton, N.B., for an eight-hour day with 70 cents an hour wages, an increase of 10 cents, have been met. The plumbers also have been grant-

ed an eight-hour day, their wages being at the same time increased to \$4.50 per day.

The month of April has shown a record in building permits issued in St. Thomas, Ont. The value for the month is \$69,725, while the total for the entire year 1918 was only \$54,395. Up until April 30, permits to the total estimate of \$90,550 had been issued this year.

The permits issued in Winnipeg for the month of April total \$239,600, as compared with \$173,900 for the same month in 1918. The total for the year up to May 1 is \$402,350, approximately the same as for the corresponding period last year, when the figure was \$404,300.

Building in Toronto appears to be going forward at a pre-war rate. For the first four months of the year the permits issued reach a value of \$3,505,806, while in the same period last year the total was \$1,857,443. In April this year there were 787 permits issued, at a value of \$1,598,686.

In Welland, Ont., the value of the building permits issued for the month of April was \$61,925, as against \$52,055 for the same month last year. The total for the year up to the end of April is \$116,280, a considerable increase over the corresponding period in 1918, when the total was \$83,695.

Work is under way on the demolition of the present structures at 60-62 King St. West, Toronto, which is to be the site of a building for the Bankers' Bond Co., Ltd. This proposed structure will be an elaborate one of the Grecian type of architecture, built of grey stone, and not more than three storeys in height.

The Canadian National Railways are preparing for the construction of their line from Humboldt to St. Brieux, Sask. It is understood that a townsitc will be established at Lenore Lake, and for this purpose a tract of land of 150 acres has been purchased at \$45 an acre. A siding will be placed at Dead Moose Lake.

An assembly hall is to be built at the Ontario Agricultural College, Guelph, Ont., in memory of the students who fell in the war. It is proposed to erect a cut-stone structure of modified Gothic design, having a seating capacity of at least 800. The cost will be \$100,000 or more, \$40,000 of which will be contributed by the Ontario Government.

The proposed \$700,000 Place Viger Terminal cold storage warehouse in Montreal will be a 10-storey structure with three sub-basements, having a frontage of 180 ft. on Notre Dame street and 83 feet on Berri street. Mr. Alcide Chaussee is preparing the plans for this building, which will likely be the most important piece of construction work to be undertaken in Montreal this year.

Mr. W. G. Chace, chief engineer of the Greater Winnipeg Water District, and four other engineers, Messrs. J. G. Sullivan, W. P. Greerton, John Woodman and J. C. Holden, have been instructed by the district board to consider the advisability of placing further drainage under a four-mile stretch of the Aqueduct. This work may possibly be made necessary on account of the alkaline nature of the soil in the section in question.

The Department of Highways of the Province of Saskatchewan proposes a big reclamation scheme in the Yellow Grass marsh district in townships 9, 1 and 11. Tenders have already been submitted for the construction of 22 miles of ditch. The water will be discharged into the Souris River, and the work will involve the excavation of 295,000 cubic yards of earth. The nature of the country will permit of the water being drained off by means of a ditch alone, no expensive flume work being necessary. The reclamation of some 14,000 acres of land and the contract will call for the completion of the work by Dec. 1, 1920.

The Taylor Engineering Co., of Vancouver, has intimated

its intention of proceeding immediately with its garden city development on the company's property adjoining Shaughnessy Heights, an area covering some 53 acres and bounded on the east by Granville Street and on the west by Angus Road. The contract has been let for breaking the ground on one of the most desirable sections of the property—the northwest corner—and as soon as this preliminary work is completed the erection of a number of six and seven-room houses will be started, the intention being to have them ready for occupation by the middle of October. The colonial cottage type of architecture will be followed.

Following a strike lasting a day and a half, the Carpenters' Section of the Guelph Builders' Exchange and the Society of Carpenters and Joiners have reached an agreement on the following basis: The carpenters will receive a net rate of 55c per hour for an eight-hour day, and 48-hour week; overtime will be paid at the rate of time and a half, except on Sundays and holidays, when it will be double time; no work on Labor Day; the Carpenters' Section of the Builders' Exchange agrees to recognize the Union; one apprentice is allowed for every four journeymen; no apprentice to commence work under the age of 18 years. Both parties signed a contract for one year, and notice as to any change in the agreement will require a three months' notice.

Thirty-three Ontario municipalities have passed the by-laws necessary to bring them within the Ontario Housing scheme and become entitled to share in the Government loan. These are: Sudbury, Windsor, Sandwich, Fort William, Hespeler, Port Dalhousie, Madoc, Galt, St. Catharines, Ingersoll, Port Credit, Oshawa, Sault Ste. Marie, Ford City, Ottawa, New Toronto, Elmira, Neebing Township, Cochrane, Trenton, Sarnia, Woodstock, Point Edward, Sturgeon Falls, Leamington, Palmerston, Richmond Hill, Perth, London, Whitby, Guelph, Niagara Falls, Listowel. The plans mapped out in these places call for loans aggregating \$8,000,000 and work has already been started at some points. The town of Ingersoll has purchased 25 acres of land in the centre of the town, which it is proposed to divide into 200 fifty-foot lots to be sold at \$30 each.

The C. P. R. has been granted charters for the construction of a number of branch lines in the west. One proposed line is from Duchess, Alta., due north for a distance of 30 miles. The cost will be \$30,000 a mile. Another is from Archive to Wymark, Sask., a distance of 150 miles. The third clause of the bill authorizing the building of a line from a point at or near Fortune or Rosetown, Saskatchewan, in a southeasterly direction for a distance of 80 miles, was passed with an amendment providing that the line should start from Rosetown. Another clause providing for a line from Leader, Sask., southwesterly a distance of thirty miles to Big Stick Lake, was amended to have the line terminate at Success instead of Big Stick Lake. A line is also projected from Lanigan, northwesterly to a point between Carrol and Saskatchewan River, and thence to Cumberland House.

GOOD ROADS ACTIVITIES

At a recent meeting of the Automobile Club of Dunnville, Ont., Warden McQuillen, of Haldimand county, announced that contracts had been let for thirteen miles of construction on the Hamilton-Port Dover road, at a figure of \$96,000, and that the total road work in the county would cost about \$150,000.

On May 23, the Ontario Department of Highways will take over the main road out of Brant county east to Hamilton as part of the provincial highway.

The route of the Kingston-Ottawa highway, crossing the counties of Frontenac, Leeds, Lanark and Carleton, and the

Rideau Lakes summer resort country enroute, has been designated for a portion of the way. It will pass through Seeley's Bay, Rideau Ferry, Perth, Carleton Place, Ashton and Stittsville. The new highway will be of considerable commercial value, as it does not parallel any line of steam railway, and will furnish an artery from Ottawa and the Ottawa valley connecting the Kingston road to Toronto. As a result of the Province taking over this road as part of the trans-provincial highway and thus relieving the counties of financial responsibility in connection with it, the latter will be able to divert their funds to the extension of their county systems. Lanark will build as a county road a highway from Lanark to the upper end of the county near Calabogie, and Carleton will build as a county road a section from Bell's Corners to the county boundary near Franktown, which ultimately will be extended to Smith's Falls, it is expected.

A proposal is brought forward for a provincial highway from Quebec City to Chambord, Lake St. John. A delegation representing the towns, the boards of trades and other public bodies, of the Lake St. John district, are visiting Quebec City to urge the advantages of this project. The distance is about three hundred miles, but as the region in question is one of the richest in production of grain and general farm produce in the province of Quebec, there are a number of arguments in favor of the undertaking. The type of construction suggested is macadam.

In accordance with the request of the miners in the district interested, the provincial government has decided to build a road to Kirkland Lake camp in Northern Ontario. The work is to be undertaken at once and will be of tar macadam construction, 16 ft. wide, it is understood.

Four delegations recently waited upon Hon. J. A. Tessier, Minister of Roads for the Province of Quebec. The first delegation asked that the proposed highway between Hull and Montreal be built during the coming months. Mr. Tessier replied that it would be considered and that an engineer would be sent to the district to make a preliminary report. The second delegation, composed of citizens of St. Ours, asked that the Government continue the construction of the St. Lambert-Levis national route beyond St. Ours. A proposed route for the highway was submitted to the Minister. Another delegation, from the county of St. John, requested the completion of the Salaberry road. The fourth delegation, consisting of citizens of St. Valentin and l'Isle aux Noix, requested that a trunk road be constructed between two roads already built in St. Valentin.

Bad roads are expensive in more ways than one. The united counties of Lennox and Addington, Ont., were recently fined \$400 for maintaining the Hamburg road in such a condition as to create a nuisance, and an additional \$100 for contempt of court in not taking any steps to abate it as directed at a previous sitting of the court.

Obituary

Mr. J. H. Lebon, of the firm of Tanguay & Lebon, architects, Quebec, died recently at the age of 45 years.

Mr. George Turner, C.E., of New Westminster, B.C., died recently in his eighty-second year. Mr. Turner was one of the pioneers who came to the banks of the Fraser River in the ranks of the Royal Engineers in 1859, and assisted in laying out the city of New Westminster. He remained with the Engineers until the corps disbanded in 1863, when he decided to settle permanently in British Columbia. Between that date and 1889, when he entered the Dominion government service, he was engaged principally in private practice as a surveyor. Latterly he had been assistant engineer on the staff of the Dominion resident engineer.

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Contractor Should Not be Held to Original Tender

HERE IS a little question in ethics which our readers may be interested in figuring out. If a government let a contract to a construction firm for specified work at a given price, and if that government's fair wage board, during the progress of the work, awards the contractor's employees increases in wages on two occasions, is the government justified in holding the contractor to the original tender price in which the labor costs were based on the rates prevalent at the time the contract was received? We don't think any fair-minded man will hesitate as to his answer.

This is exactly the case in connection with the contract for the Manitoba parliament buildings. The contractors, the J. G. Macdiarmid Co., have urged upon the provincial government, that owing to the increases in wages awarded by the government fair wage board, since they signed the contract in 1916, they are entitled extra remuneration covering the difference in cost thus caused. The government, however, refuses their plea.

As an average of 150 men have been employed for a period of nearly two years, a large amount of money is involved. The question has now been referred to ar-

bitration, F. B. Hazleton, of the Builders' Exchange, acting for the contractors, and Geo. Northwood, architect, for the Government. If these are unable to arrive at a satisfactory agreement, a third arbitrator may be called in.

It seems to us that there is no question but that the contractors are entitled to receive, in addition to their contract price, the full amount of the increase involved. It is altogether unjust to expect that they should stand a loss of thousands of dollars due to conditions altogether beyond their control. We do not believe that any reputable private concern, under such circumstances as these, would refuse to share, at least, in the increased cost. The Parliament building at Ottawa, as recently announced by the Minister of Public Works, is going to cost \$8,000,000, or \$3,000,000 more than the original estimate. This is a cost-plus contract and so there is no loss involved to the contractors, but if it had been a lump-sum contract, would they have been made responsible for the extra \$3,000,000? This would just be a parallel case to the Manitoba Parliament Building contract.

To Democratize Construction Industry

THE directors of the National Federation of Construction Industries (U.S.A.) are considering calling a National Conference of representatives concerned with the construction industry, consisting of manufacturers, distributors, consumers, labor, agriculture, transportation and finance.

Lack of co-operation between the various factors concerned in the construction industry, rather than the high cost of materials and labor, is responsible for the retardation of building enterprises, declares E. T. Trigg of Philadelphia, president of the Federation. Before the much longed for building boom can be got under way, says Mr. Trigg, these various factors—including, of course, labor, capital and the consumer—must be brought together in a common understanding of the actual conditions facing the building trade. It is with the idea of bringing them into touch with each other that the directors of the National Federation of Construction Industries are considering the calling of a monster conference for the "democratization" of the construction industry.

The directors of the federation have been working for weeks on the details of the conference, and representatives of the various groups concerned have held several meetings. The most recent of these meetings was that held by representatives of the producing and distributing interests in a large Eastern city a short time ago.

"For the past two years" said Mr. Trigg, in discussing the purposes of the contemplated convention, "building construction has been at a standstill. This condition, it appears, is psychological rather than material. Labor is available, money is at hand, material is abundant and the need for construction is pressing. All of the elements for active business are present, but construction does not resume. Many people seem to feel that we shall revert to pre-war prices, and they are apparently postponing construction until reductions in prices are realized. An examination of the history of prices shows clearly that after none of the wars of modern times in any part of the world have prices reverted to the pre-war status."

"The increase in prices in the United States during the recent war has been much less than elsewhere,

with the exception of Australia and New Zealand. Nevertheless prices here are not only higher than they were before the war but give promise of having reached a new permanent level. This information, however, has not filtered down to the mass of the people, and the directors of the federation feel that they should call together a conference in which all the parties directly or indirectly interested in the construction industry may come to an understanding relative to the new economic conditions.

To Democratize Industry

"It is believed that such a conference would devise a construction programme applicable to present conditions. Our trouble seems to be a lack of information and of understanding, an exaggeration of the importance of group interests and a mutual distrust, arising chiefly from a lack of contact and acquaintance between the members of the several groups. We have all acknowledged the solidarity of the human race, but we have failed to recognize the necessity of applying the same principle to business.

Labor, agriculture and commerce have failed to apprehend fully their necessary interdependence. This is not to be wondered at when we remember that hitherto agricultural societies have met by themselves, organized labor by itself, and commerce by itself, and each has taken counsel how best to advance its own interests without obtaining the advice or information of, or considering the effect upon, the other two. This one-sided view is the cause of many of our difficulties and estrangements."

Through such a conference as had been proposed, it is expected that the farmers, the workmen and the business executives, interested in construction, who jointly are the producers and the consumers of construction commodities, would, by candid discussion and sincere examination of the views expressed by the others, arrive at the conclusion that the democracy of the construction industry is as essential as that of the Government.

Housing Suggestions for Winnipeg

AT a recent meeting of the civic housing committee in Winnipeg, the following resolution was passed:

"That a committee be formed to borrow \$1,000,000 from the provincial government for the erection of houses for returned soldiers and others as suggested in the general policy of the housing scheme; (2) that the houses be built by the city on plans submitted by the building inspector and approved by the civic housing committee and sold on the amortization plan; (3) that five-room cottages, 24 by 32 feet, as in plan No. 1 and single cottages as in plan No. 4, be the style adopted by the committee, and the frontage of the lots be restricted to not less than 33 feet; (4) that a cash payment of not less than 10 per cent. of the total cost be asked of the purchaser; (5) that tenders be called for the purchase of lots suitable for the erection of these houses, said lots to be convenient to sewer and water; (6) that applications be received up to June 1 from soldiers and others desiring such homes to take advantage of the proposed housing scheme."

Plans and specifications for houses suitable for erection under the housing scheme were submitted by Building Inspector E. H. Rodgers, four plans being suggested. The first is for a storey and a half, five room house, 20 by 24 feet. The estimated cost for such a dwelling of frame construction would be \$2,765

and, if built of brick, \$3,168. Plan No. 2 calls for a storey and a half, five-room house of 40 feet frontage, with a depth of 25 feet. This would make two houses of 20 feet frontage each, with a brick division wall. The cost for frame construction would be \$5,760, and for brick construction, \$6,600. The third plan submitted was for a storey and a half, four-room double house, 24' x 36', semi-detached, at a cost of \$5,456.64 for frame construction, and \$5,702.40, of brick construction. The fourth plan calls for a single cottage of five rooms and basement, 24 feet by 32 feet, at a cost of \$2,857 for frame construction, and \$3,285 for brick construction.

Provincial Highways in Quebec Done Away With

ADEPUTATION which waited on Sir Lomer Gouin, in Montreal, requested the construction of a road from Montreal to Mont Laurier, via St. Rose (now completed), St. Therese, St. Agatha and Nominigüe, a distance of 140 miles, part of which will be through the Laurentian Mountains. Sir Lomer questioned whether the municipalities would be able to bear the interest of the amount involved. The Government had been asked to reduce the interest on money loaned, but he was not sure that this could be done. An engineer will be sent to look over the route, and the Government will then decide. The Government rate on loans is now 3 per cent. The Government early in its policy for good roads, also decided to build provincial highways and charge the municipalities, as their contribution, \$1,000 per mile, but this has been abandoned, and all roads, whether rural or not, have to be built by the municipalities paying 3 per cent. interest on the money, thus doing away with provincial highways as at first intended.

The Provincial Government has an elaborate programme for roads, providing that the money comes from the Federal treasury, basing this hope on reports from Ottawa to the effect that the Federal Government intended to devote money to road building in Canada.

Itinerary of Royal Naval Exhibition

The Royal Naval Exhibition, comprising a wonderful display of photographs showing the activities of the Navy in the war, is being shown at all possible centres throughout the Dominion. In Toronto and Hamilton, where this remarkable set of pictures has been displayed, great interest has been taken, and to stimulate further interest in the exhibition we are publishing the following itinerary: London, May 19 to 26; Windsor, June 2 to 7; Port Arthur, June 23 to 28; Winnipeg, July 7 to 12; Regina, July 21 to 26.

Calgary, Vancouver, Victoria, Edmonton, Saskatoon, Sherbrooke, Quebec, St. John and Halifax will also have an opportunity of seeing this display at dates not yet determined. The exhibition is under the auspices of the Navy League of Canada.

The council of York Township, Ontario, has passed by-laws authorizing: 84,400 lineal feet of 6-in. water mains, 16,455 feet of concrete sidewalks, and 4,385 feet of asphalt pavement. These will be carried out under the jurisdiction of Frank Barber, township engineer, and his associate R. O. Wynne-Roberts.

Dominion Power and Transmission Co.'s Plant

Description of the Coal Handling and Boiler House Equipment
That is Increasing the Efficiency of Steam-Electric Station

The steam plant of the Dominion Power & Transmission Company, located just outside the city limits of Hamilton, on the shores of Burlington Bay, has now been operating for over a year and in point of efficiency is more than meeting the strict specifications laid down for it by its designers. By its dependability it has also demonstrated, in a general way, the soundness of the argument that where conditions of use are such that the customer is prepared to pay for a more perfect service, the hydro-electric plant supplemented by the steam plant frequently offers the only solution. Where the load is purely a lighting proposition it is not, of course, a matter of such supreme importance that short shutdowns should be guarded against, but where it is a matter of dol-

of service rendered by different systems as there is between any other two things we buy. It follows, naturally, therefore, that the cheapest is not always the best.

The plant is situated just outside the eastern limits of the city of Hamilton, Canada, on the southern shores of Burlington Bay. It is designed for an ultimate capacity of 75,000 kv.a., 25,000 kv.a. of which has been installed at date of writing. The station forms part of the system of the Dominion Power & Transmission Company, and delivers its output at 44,000 volts to the high tension lines of the company. In addition to its generating capacity the station is designed to act as a stepdown transformer station of 25,000 kv.a. capacity to transform the high tension current to 13,200 volts for dis-

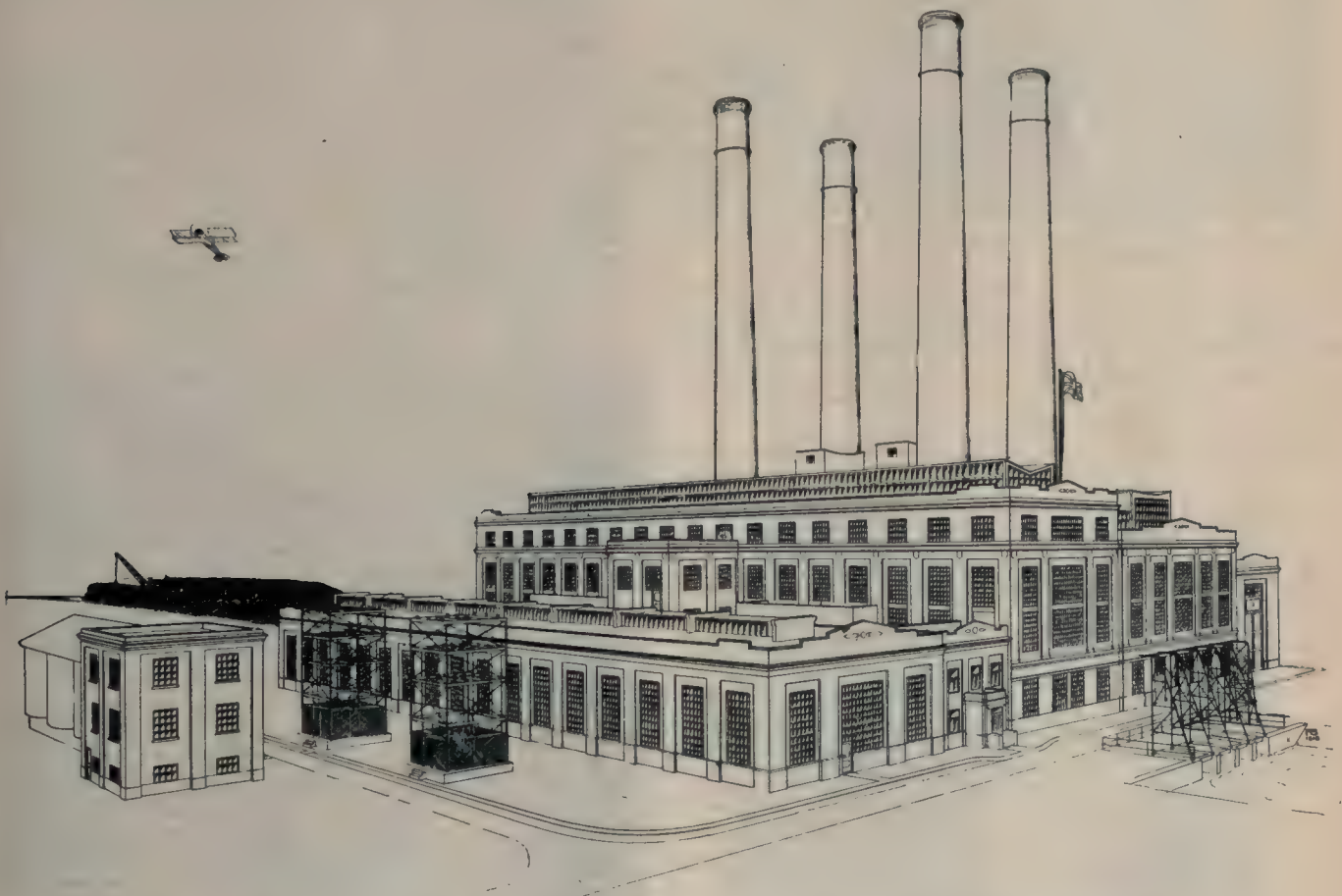


Fig. 1. The steam-electric plant of the Dominion Power and Transmission Co. as it will look when completed

lars and cents or where great inconvenience is caused by power delays, such as, for example, in the operation of electric furnaces, industrial plants operated electrically and involving a large amount of labor, electric cooking in the home and so on, then it is easily seen that the small added cost of a continuous service may be offset many times by the losses entailed by one or two protracted delays. This is a point frequently lost sight of by customers in making comparison between rates in various cities or rates charged for various operations or by competing companies. There is as much difference, generally speaking, between the different kinds

of service rendered by different systems as there is between any other two things we buy. It follows, naturally, therefore, that the cheapest is not always the best.

The general arrangement of the plant as shown in diagram, Fig. 2, is very largely responsible for the very efficient figures of operation which this plant has shown. The coal is taken from storage yards (see Fig. 1), or direct from trains and deposited over the crusher hopper into auxiliary storage in the coal building shown at the extreme right of the diagram. The coal is crushed as required, and elevated by means of bucket conveyor to the storage bunkers above the boilers

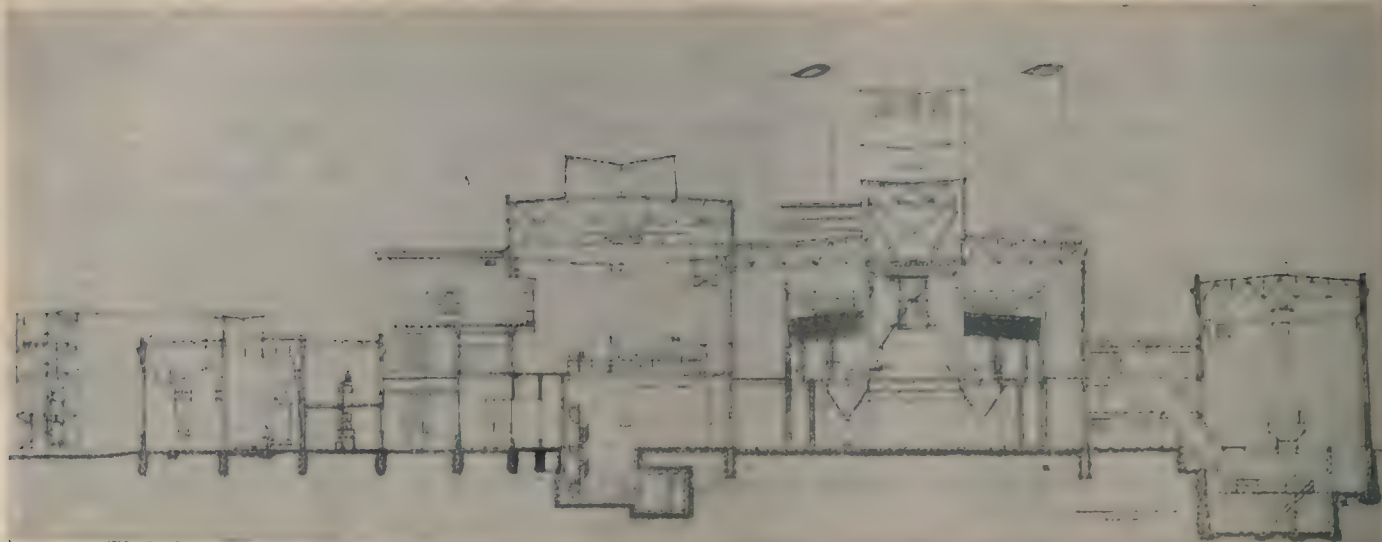


Fig. 2.—General arrangement of plant. From right to left, coal, boilers, steam plant, electrical equipment

shown in the diagram. A weighing larry distributes the fuel from these bunkers to the stokers.

The coal handling plant has a capacity of 60 tons per hour. The feeder is a steel cased double plunger with opening 26 in. x 30 in. Coal is moved by two plungers, operated by adjustable eccentrics placed one 90 deg. in advance of other. Power is provided by means of sprocket and chain drive from crusher countershaft. Clutch is furnished so feeder may be cut out and crusher driven independently. Discharge of feeder is coupled direct to top of 2 roll crusher. The crusher is a 2-roll type direct geared to 25 h.p. Westinghouse at 750 r.p.m. One roll shaft is supported on rigid, the other on adjustable bearings sliding in guides and backed up by heavy coiled springs. Rolls are set to deliver coal at 2 in. and under. Each roll consists of 2 heavy cast iron spiders supporting 6 cast steel segments. The roll shaft is 4-7/16 in. diameter. The rolls are 26 in. diameter, 24 in. long.

The elevator has a length of 38 feet centres, bucket type. The casing is 5 ft. 0 in. high by 9 ft. 0 in. wide, with ladders on either side of elevator.

The weighing larry has rail centres 21 ft.; hopper capacity 5 ton; hopper scale, 10 ton capacity, with reverse reading beam. Spouts lead from hopper for delivery to stokers with gates operated from cage. The traversing motor, direct geared to trucks, is Westinghouse slip-ring polyphase, type H.F., 5 h.p., speed 935 r.p.m., 3 phase, 550 volts, 662/3 cycles.

The coal bunker has a capacity of 420 tons. It is equipped with three 18 in. x 18 in. double undercut gates operated by lever from weighing larry. Coal storage building has a capacity of 1,250 tons.

The stokers are the Taylor Stoker Company type. There are four 11 retort stokers, with width 19 ft. 6 in. and depth 8 ft. 3 1/2 in. There are 3 dampers with each stoker and each is also supplied with one side cleaning and two front observation doors. Each pair of stokers has two engines. There are two fan engines and one horizontal for each pair of boilers, two fans for each pair of boilers with two paddle wheels, capable of delivering sufficient air to operate all stokers at 150 per cent rating.

The Boilers

The water tube boilers are by the Edgemoor Iron Company. There are four 1,050 h.p. boilers, set singly. The plates are of open hearth steel. The headers are of flange steel plates, attached to drums by flanges, expanded into inner plates of header; manholes are provided with forged steel covers. Flanged oval hand holes, fitted like manholes, are placed opposite each tube; these oval covers being inside are tightened by boiler pressure and independently removable.

The drums have an outside diameter of 35 1/8 in., length 20 ft., made of fire box steel, longitudinal seams, double butt strapped triple riveted. Each boiler has four drums of plates, 7/16 in. thick.

Each boiler has 472 Am. standard soft steel tubes, 4 in diameter, 20 ft. long, 2 lower rows No. 9 gauge, balance No. 10. Valves and fittings are as follows:

Three 4 1/2 in. Ashton pop safety valves; four 2 in. Hancock feed water valves; four 2 in. Hancock check valves; two 2 1/2 in. Faber blowoff valves; two 2 1/2 in. Homestead blowoff cocks; one 12 in. Ashcroft steam gauge; one Reliance water column with water gauge and three try cocks.

The fronts are fitted with rolling tube header door. Heat-



Fig. 3.—Showing one side of Boiler Room and 6-ton coal larry.

ing surface is 10,470 sq. ft. per boiler. The weight, approximate, 150,000 lbs. each.

Four Foster superheaters are installed, guaranteed to raise the temperature of 31,500 lbs. of steam per hour, at pressure 200 lbs. per sq. in., to 5,380 F. corresponding to superheat at 150 deg. With boiler operating at 150 per cent. rating, superheat is 160 deg.

The stokers feed the boilers at a sufficient rate to force them to 235 per cent. of rating without difficulty. Fig. 3 shows a view of a portion of the boiler-room. The boilers

are equipped with automatic soot blowers and the customary instruments to enable the engineers to operate the boiler intelligently. The flue gases are carried away by two radial brick chimneys.

The chimneys were built by the Canadian Kellogg Company. Dimensions:

Height above foundations, 240 ft.; internal top diameter, 12 ft.; height of base, 22 ft.; cross section of base, round in shape, 22 ft. 2 in. diameter; lining 40 ft. high from point 2 ft. below flue opening; Baffle 20 ft. high and 8 in. thick; lightning conductor 6 copper points, $\frac{3}{4}$ in. diameter, 8 ft. long, with $1\frac{1}{2}$ in. solid platinum tips. Lower ends of points connected to proper cable encircling chimney from this cable; one 7/16 in. 7 strand No. 10 Stubbs gauge copper cable is carried to ground and connected to copper ground plates; one 4 in. H. & M. patent gauge and connections; one 2 in. pyrometer connection; steps of $\frac{5}{8}$ in. galvanized round iron

of 3/16 sheet steel, provided with hand operated stirring device.

The filter tanks are two in number, 8 ft. 0 in. in diameter, 5 ft. 4 in. high, inside dimensions of $2\frac{3}{4}$ in., Washington fir, round steel with hoops and malleable iron draw lugs. Cross connected, provided with galvanized iron distributing and wash water overflow trough. A filter bed of crushed quartz (98 per cent. silica) is supported by layer of washed and graded grav-



Fig. 4.—View of 1050 h.p. Edgemoor boilers during erection.

built in on inside of chimneys, spaced 18 in. C. to C.; two cast iron cleaning doors; cement caps put on each chimney and painted two coats heavy pitch.

Water Purification

Make-up water for the plant is obtained from Burlington Bay and is successfully treated by the We-Fu-Go system of water purification. The water softening building is shown at the left of Fig. 1.

The two reaction and settling tanks are: 24 ft. 6 in. in diameter, 19 ft. 4 in. high, dressed Washington fir, $2\frac{3}{4}$ in. thick, fitted with round steel hoops and malleable iron draw lugs. Tanks are provided with steel ladder outside and wooden ladder inside with platform at top of outside ladder, both tanks are covered. One inch pipe connection is provided for drawing samples, also mercury depth gauge. Gauges and brass faucets are mounted above white enamel iron sink on enamelled plate. Electric contact alarm bell is operated by copper float; a double throw switch admits connections to either tank.

The tanks are equipped with mechanical stirring device, each tank taking four hours for treatment of its capacity of water. Water is supplied to tank at rate of 60,000 U. S. gallons per hour.

The Reagent mixing tank is 3 ft. in diameter, 2 ft. high,



Fig. 5.—View of eleven retort stokers during erection.

el. The inlet pipes are provided with brass fitted balanced valves and seamless copper floats, to regulate flow of water from settling tank, and maintain uniform level in filter. An electric alarm bell, operated by copper float rings in water softener and boiler-room.

The air wash pipes in filter bed have discharge openings

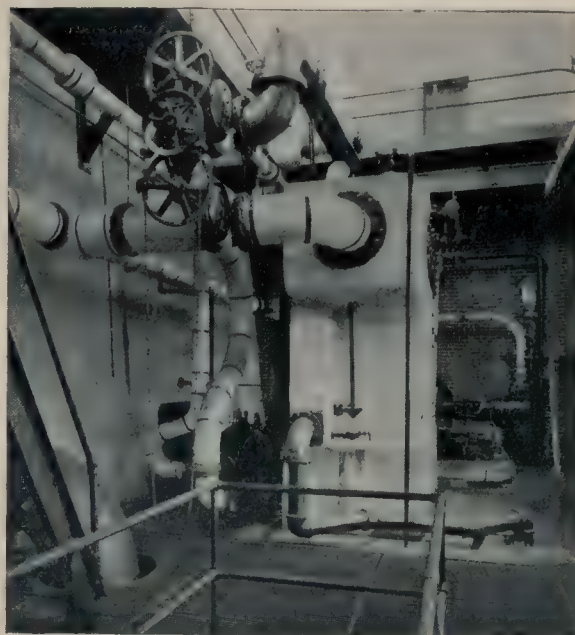


Fig. 6.—Heater, feed pumps, air pump, fan engine, in pump pit.

equally distributed over filter bed and connected to pressure blower. The valves are controlled by numbered cast iron floor stands having extension stems where main operating valves are below floor.

New Water Supply Scheme For Moose Jaw

City Engineer Outlines Solution for Present Supply Problem—\$1,630,000 Will Construct Works to Use Saskatchewan River, 70 Miles Away, as Source

AT a meeting held in Moose Jaw, Sask., on April 30, at which representatives of nearly every Moose Jaw organization were present, steps were taken and a committee was appointed to immediately take up the question of the Saskatchewan River water scheme for Moose Jaw, as outlined by City Engineer G. D. Mackie, which, in the unanimous opinion of the meeting, was the only solution for the water problem that now exists.

Commissioner Mackie, although he mentioned several alternatives in his address, favored, for financial reasons, the plan for a 24 inch continuous wood stave pipe-line from the Caron head-works to the Saskatchewan River, a distance of between 54 and 70 miles, depending on the route selected, which can be constructed and in operation, if started at once, by October 1st this year, at an outside cost of \$1,630,000, with an effect on the mill rate of from 5 to 7 mills, depending on the city assessment, if the city pays the entire cost, or of one mill only if it is found possible to secure aid from other sources as suggested.

Committee Named to Start Work

The meeting, which was called under the auspices of the Board of Trade, at the suggestion of President George A. Maybee, resolved itself into a Citizens' Committee, with Mayor Hamilton as chairman. Mr. Mackie was then called upon to make his address, and following that, a short discussion which occurred, was brought to a close by a motion moved by William Grayson and seconded by George C. Ingram, that the men named below be appointed a committee to immediately go into the engineering, financial and legislative problems that surround the scheme, and report back to a meeting of citizens to be held in the near future.

Mr. Grayson named the following members of the committee: Mayor S. A. Hamilton, City Engineer Commissioner G. D. Mackie, Aldermen W. G. Ross and W. D. McIntyre, President George A. Maybee of the Board of Trade, Arthur Hitchcock, John H. Grayson, ex-Mayor W. W. Davidson, W. Gardner, and W. E. Stephenson of the Moose Jaw Trades and Labor Council Executive.

Present Supply

Mr. Mackie, in discussing the water situation, dealt with the present water supply of the city, pointing out the fact that the maximum summer flow is now one million gallons per day, and that the maximum winter flow varies from 800,000 gallons per day, to as low as 700,000 gallons per day. The average consumption per head per day in 20 cities of Alberta is 74.5 gallons. In ten Saskatchewan towns the average is 47.9 gallons per head per day, and in the Dominion, as a whole, it is 111 gallons per head per day. Moose Jaw's average consumption per head per day is 53 gallons.

In dealing with the industrial water consumption of the city Mr. Mackie stated that in Moose Jaw the industries consumed more water than those in any other city in the Province, and that in the months

of January, February and March of this year one firm alone consumed 300,000 to 350,000 gallons per day. The water situation as a whole, he said, was that the city has a possible maximum supply of one million gallons per day, and that the average consumption in 1918 was 883,000 gallons per day, and that the industrial consumption had increased from 150,000 gallons per day in 1914 to an average of between 300,000 and 350,000 gallons per day.

Cost per Head will be High

Dealing with the cost of Moose Jaw's water system, the commissioner said that Moose Jaw's water system, if carried out as per his proposed scheme, would be the most expensive per head in the Dominion. To date the total expenditure on the city's water system is \$67.65 per capita. The expenditure to date per head in the Greater Winnipeg water area is now \$106.53, and Moose Jaw's, if the Saskatchewan river line is built, will be \$149.15 per head.

Referring to a previous meeting at which he made the statement that there was sufficient water in Moose Jaw Creek to supply the city's needs for several years to come, Mr. Mackie said that he could only repeat that statement. The average run-off of the creek per year for eight years is seven and one-half billion gallons. Were that scheme gone ahead with, it would be necessary to build a ten billion gallon reservoir, which would hold enough water to supply the present population for three years. The land that would be flooded by such a reservoir would be five thousand acres, and the minimum estimated cost would be \$1,250,000, of which amount \$450,000 would be required for the pipe line alone. Of that sum \$400,000 would have to be spent in the east end of the city, because of the fact that there is not at present any water main system there to connect with the mains large enough to start the distribution within the city of such a large amount of water. In addition, another disadvantage of this proposal is that if the city outgrows the supply that can be secured from the Moose Jaw Creek, the expenditure entailed in construction will be lost, because the next scheme possible of consideration is the Saskatchewan River. If the cost is at all comparable there is no doubt that the Saskatchewan River scheme is the better of the two.

Saskatchewan River Scheme

Mr. Mackie then considered the Saskatchewan River as a source of water supply for Moose Jaw. Mr. Francis, who was the engineer in charge of the Caron waterworks construction, and who recommended the Caron scheme over the Moose Jaw Creek, although admitting that it was only a tentative solution, did recommend Caron, because it was a distance of 20 miles gained toward the then considered ultimate solution, the Saskatchewan River, while the Moose Jaw Creek did not offer that advantage. Mr. Francis, however, estimated on the Saskatchewan River scheme, and his figure was five million dollars.

Various Dominion Government schemes are estimated at between eight and fifteen million dollars.

Major McPherson, who proposed to build an open ditch carrying water from Pelican Lake, and through Thunder Creek, estimated his project at \$850,000, but the disadvantages of his scheme were that the city would have such a supply available for but seven or eight months of the year, and that in order to secure a million gallons per day it would be necessary to pump between ten and twelve million gallons to take care of evaporation and precolation over the 60-mile open ditch. A further disadvantage is that a flow of but one foot every two seconds could be secured, which is too slow for the purpose.

Local Possibilities Small

It is possible by further development, to augment the city's present supply locally, but the outside estimate made by Mr. Mackie is that 150,000 gallons per day could be thus secured, which amount, in his opinion, is not worth considering. With the stock yards in operation, they with the packing house and the C.P.R. could be expected to consume from one-half to three-quarters of a million gallons per day next winter.

His Saskatchewan River scheme, he said, included pumping at the river of all the water through a pressure pipe to the heights of land, a height of 330 feet, into a two million gallon reservoir, and from there to the Caron headworks through a 24 inch continuous wooden stave pipe line.

62 Mile Pipe Line

The shortest route from Caron to the river is 54 miles and the longest route considered is 70 miles. The short route cannot be used however, owing to the fact that high ground intervenes between the river and Caron. In Mr. Mackie's opinion it will be necessary to build a pipe line of 60 to 62 miles to get the gravity flow from the height of land at the river to Caron. A survey would have to be made to determine the best route, as every mile of pipe line means a saving of \$17,000.

In determining the size of pipe to be used for his scheme, Mr. Mackie stated that he started with the consideration of four million gallons per day capacity, an amount larger than the present needs. He therefore proposes a pump at the river sufficient only for the present needs, and to keep the cost as low as possible, has not provided for stand-by pumps in the event of break down. This means that it could be figured that the pump at the river would have to be shut down two days per month because of accident, during which time the Caron system would be in a position to supply the city's wants. No filters would be used, it being planned to use the same type of infiltration gallery as in use at Battleford and North Battleford.

Wooden Pipe Cheapest

"The cost of the auxiliaries to such a scheme," said Mr. Mackie, "is a mere bagatelle to the cost of the pipe line. There has been a great deal of discussion here on wooden pipe lines, but I intend to advocate a wooden pipe line for financial reasons." He then quoted figures showing that the cost of 24 inch wooden pipe laid in the ground, exclusive of the cost of excavation and back-filling is \$2.30 per foot, of steel \$5.74 per foot, and cast iron \$10.51 per foot. The cost therefore for 70 miles of wooden pipe would be \$850,000; for steel \$2,123,000; and for cast iron \$3,890,000. In addition there would be a tremendous

saving in the tonnage hauling cost, the wood tonnage being about 9,000 tons, steel 15,000 tons, and the cast iron the heaviest, about 45,000 tons.

The outside costs of the entire scheme for the three types of pipe, wood, steel and cast iron, were quoted by Mr. Mackie as follows: wood \$1,630,000; steel, \$2,900,000; iron, \$5,000,000.

Figuring the life of the wooden pipe line at but fifteen years, he said the saving on the carrying charges would be some \$60,000 per year, which would amount in fifteen years to a sum sufficient to enable the city to replace the wooden pipe line.

Total Cost \$1,630,000

The cost of the system with 24 inch wood pipe, would be as follows:

Diesel engine and pump at river	\$148,000
Force pipe to height of land, 330 ft. . .	65,000
2 million gallon reservoir at river . .	65,000
Pipe line laid	1,184,925
Damages	88,630
Engineering and contingencies	78,445

Total \$1,630,000

In further describing the type of pipe line recommended, Mr. Mackie declared that it is different from the old type in that it is of the continuous stave type, thus avoiding joint and the leakage which occurred and always will occur in such joint. In addition, the bands of the pipe, instead of being continuous, are individual, so that when one break occurs the whole pipe will not leak, as in the case of the Snowdy Spring line, for instance. He would lay the pipe but 6 feet in the ground, sufficient only to protect it from rodents, etc., and to keep it below ground. That depth is sufficient to protect from frost at the velocity the water would travel through it. The El Paso Railway was faced with a similar situation for water, he said, and decided on wood because of the prohibitive cost of iron or steel. They now have 116 miles of this pipe in operation and it is giving satisfaction.

The present Caron line has a capacity for 2,400,000 gallons per day. This can be increased to a maximum of 3,960,000 gallons per day, by different placing of pumps, and different methods of taking water from new to old pipe line, either through Caron reservoir, or direct to the old pipe line. The minimum winter flow of the Saskatchewan River in the winter time at Saskatoon, is 600 million gallons per day.

The Financial Problem

In conclusion, Mr. Mackie dealt with the financial aspect of the scheme, saying that while it did not present any engineering difficulties, it does present financial difficulties.

He presupposes the issue of 20 year debentures, assuming that the life of the wooden pipe is fifteen years. In the life of the pipe he plans to set aside a sum of \$400,000, which, after the debentures had been retired, could be used as a nest egg for the replacing of the line. The interest charges on this basis, at 5½ per cent. would be as follows: interest charges, \$89,000 per year; sinking fund payments, \$54,000, and depreciation, \$20,000 per year; a total of \$163,000 per year, which, added to the carrying charges of the present waterworks, would make the carrying charges for the entire system \$318,000 per year. Figuring on the sale of half a million gallons per day more water

than at present, the annual deficit on water would be \$116,000 year, which on the present assessment would cost the citizens 7 mills additional tax rate.

On the 1913 assessment he said this could be handled by 3 mills additional levy.

Mr. Mackie next dealt with the city's borrowing power, which at the present time is \$400,000 in round figures. His suggestions for increasing it to bring down the mill rate necessary to handle the water system proposed were several. One method was by increasing the improvement assessment to 60 per cent.

instead of the present 45 per cent. Another was to revert to the old business tax assessment instead of the present business license. A third was to increase the present land assessment by four million dollars. All three of these suggestions, if adopted, would bring the city assessment up to \$31,000,000 and would make possible the carrying cost of the proposed and present water system 5 mills instead of 7 mills.

It was stated that if this scheme were commenced at once, the pipe line could be in operation by October 1st, 1919.

Welland Contractors Have Organization Idea

Builders of Welland, Ont. Take Initial Step Towards Formation of a Live Exchange—Representatives of Provincial Association Lend Their Help

THERE is an old and true proverb that "Necessity is the mother of invention," and in these days it can be said with equal truth that "Necessity is the mother of organization." Some will tell you that the country has gone "dippy" on organization—perhaps that's right, but the reason is that we can't get along without it. The time has come when organization is not only desirable but absolutely essential to the effective operation of any industry. Some of our industries have been behind hand in organization, and now they are striving hard to overcome the handicap and get into stride with those more fortunate industries in which strong organizations already exist. This is what the building industry is doing at the present time, and with the proper amount of enthusiasm and a workable scheme of organization, such as is being promoted by the Provincial Builders' and Supply Association of Ontario, they are going to succeed.

Employers' Organization to Keep Industry Balanced

"But what is this great necessity for organization?" some sceptic who hasn't as yet come "up against it," will ask. Ask the building men in Welland, Ont., and they'll tell you. The bricklayers' union in that town have notified their employers that at the expiration of their present agreement their wages will be 85 cents an hour, and the carpenters say they'll have 80 cents. It's not a matter of a request, or even a demand, just a notification of what the conditions are going to be. It doesn't require any very deep reasoning to see that if on one side there's a strong union and on the other an ineffective organization or none at all, the industry is going to be unbalanced, and in the building trade it's most frequently the employers' end of it that is "up in the air."

Such conditions as these convinced the building contractors of Welland, Ont., that an organization of their own would not be out of place, and so they took advantage of the offer of the Provincial Builders' & Supply Association to have representatives visit Welland and tell them the best way to set about the work of forming one. Accordingly a banquet was arranged for Friday evening, May 9, and two Toronto men, Mr. C. F. Till and Mr. G. T. Gayton, were there to impart some of their knowledge and experience; also a representative of the Contract Record.

All the Men Connected with Industry Should Join In

Mr. W. J. Hickey was elected chairman of the evening, and after a plentiful repast had put everybody

in good humor, the meeting settled down to the more serious business. Mr. Hickey pointed out that it was their object to bring about a closer co-operation than had existed in the past in order to improve conditions in the trade. While the men present were building contractors, he saw no reason why the supply and the allied trades should not be equally interested, and if they all came in their organization would be more effective. If it was good for one, it should be good for all. Exchanges in other towns had been waking up and the Toronto Exchange, in particular, seemed more alive at the present time than it had been in many years. The chairman then called upon Mr. Till to give them some information and advice as to how they should go about the work of organization in Welland.

Mr. Till pointed out that the first step was the nomination of officers and the drawing up of by-laws for a constitution. All the points in connection with these by-laws, however, could not be settled in two or three evenings, and would have to be dealt with as they came up. To start with, it would be necessary to decide whether it would be wise to have sections. In Toronto a general charter had been taken out by the Exchange, and it was governed by the President, Vice-president, Secretary, and one representative from each section. Up until recently the sections had been taking separate action on labor matters, but now each section notified the board of directors to take action and it seemed that there were several reasons why all sections should be kept advised, in this way, of the arrangements of any individual section. As to the term "Section," in Toronto they were trying to get away from it and substitute "Association" as a more suitable and better-sounding name.

Organization Gives the Individual a Lever

These minor points, however, Mr. Till pointed out, were aside from the main object of getting together for the common good. He cited as one instance of how organization benefited the individual, the matter of the Workmen's Compensation Act. Individual members had sought for changes without success, and it was only when the weight of the Provincial Association was brought to bear that the Board sat up and took notice. One provision in this Act which they were seeking to have eliminated was that regarding merit rating. A member of the Toronto Association had suffered considerable loss through no fault of his own, on account of this rating. He had to pay \$1,000 for one accident which occurred in 1917. It was on a percentage job,

for which he had received his final cheque, and so he had no redress.

Another matter which the association had taken up was the Mechanics' Lien Act. They had made some suggestions to the Government in regard to it, and the lumbermen also came along with a suggested amendment providing for a hold-back of 30 per cent. Another proposal of the lumbermen was that if an owner let a contract for less than the job was worth, he should be made responsible for whatever the contract should have been. The Government had not taken action, but had appointed a committee to undertake the remodeling of the entire act, as at the present time it is a hashed-up proposition, and in the meantime the interested parties are to get together.

The More You Put In the More You Get Out

Mr. Till said he was sure that the supply men would be interested in the formation of the Exchange, and he urged that they should not be afraid of making the fees high. The members would think all the more of it, and the benefits would be apparent in a few months. He suggested that in making arrangements with the labor unions, they should make them from Jan. 1 if possible, in order to prevent labor difficulties at the busy season of the year. Also he suggested that if it were decided to form different sections of the Exchange, they should arrange to have their representatives to the Exchange executive appointed before the annual meeting of the main body.

In reply to a question by Mr. W. G. Somerville, as to whether it would be advisable to invite the plumbers and painters to join in, Mr. Till pointed out that the Dominion organization was being organized along those lines and there did not seem to be any objection to it.

An Opportunity to Standardize Overhead

Mr. Hickey thought that one considerable benefit to be derived from the association would be in the matter of overhead. There were a number of contractors who did not figure enough for this item, and no doubt it would be to their advantage to discuss the question and arrive at some estimate as to what percentage would cover it fully.

Mr. Gayton was next called upon to speak. He expressed his great pleasure in coming down to Welland and meeting the local building men. He had been in the building game ever since he could remember and he felt he had mixed with some of the best men the country could offer.

One need for organization was to provide protection, so that they would not have to accept injustices from architects or any one else. He had studied organization for fifteen years and believed that it was necessary if they were to make their lives worth while. "If organization is good," the speaker said, "and we all admit that it is, remember then to put your shoulder to the wheel, because we are up against different conditions to-day than ever before. And at the same time we must not forget that the workmen are human, just as ourselves. You all know that there is unrest, and there is a feeling that must be removed. You can't go to the men the way you could five years ago, but the time will come when, through organization, we will be able to hold our own."

Get Into the Spirit of the Thing

"One important point is to create a good spirit among each other. The better you become acquainted, the more effective the organization will be. We

have found this out during the past twelve months in Toronto, and we have been able to get together and talk about our difficulties in a way that helped everybody. When you meet in that way you get each other's confidence and you get to that point where you can trust each other.

"It doesn't do any good to pick flaws in our business. The higher we can hold ourselves up, the better it will be for us. We have probably more to put up with than the men in any other business, but having got into the building game, we are enthused over it, and we like it. And there's no use in grumbling about conditions if we don't go ahead and try to remedy them. Let us forget yesterday and live for the future. The thing that would do three or four years ago won't do to-day."

Mr. Somerville asked whether in Toronto the unions and the Builders' Exchange met and consulted each other. Mr. Gayton replied. "Yes, about every three months."

Mr. Dilworth said that last year the carpenters' rate was 55 cents, but work had hardly opened up in May when they wouldn't work for less than 60 cents.

In reply to a question from Mr. J. C. Diffin as to what remedy there was when the manufacturers would pay more than the union rates, Mr. Gayton said that the union should control that condition.

Mr. Till pointed out that the Boss Masons' Association of the United States and Canada was working out a standard agreement.

There was some discussion on the question of overhead, and it seemed to be the general opinion that it was through not making sufficient provision for this item that contractors most often lost money. Mr. Hickey believe it would be well for them to agree among themselves upon a fixed overhead, and Mr. Jas. Hannell pointed out that if a contractor did his own office work, there should be some basis of remuneration. It was suggested by Mr. J. C. Diffin that the overhead expenses should be figured at the end of the year and the percentage ascertained on the actual amount of business done, in this way fixing a percentage to be added for overhead on all work.

The Workmen's Compensation Act was also discussed, and the remarks indicated that the merit rating clause did not work well in the case of the contractors.

Coming again to the question of organization, the chairman asked the meeting how many were in favor of forming a Builders' Exchange in the city of Welland. All were in favor of this action. Nominations for the officers were then opened. On motion of Mr. Diffin, seconded by Mr. Somerville, Mr. Hickey was elected President. Mr. Diffin was elected vice-president. Mr. F. S. Dilworth was nominated for secretary by Mr. Hannell, seconded by Mr. Barrett, and was elected. On the nomination of Mr. Somerville, seconded by Mr. White, Mr. Mitchell was elected treasurer.

The meeting closed with a vote of thanks to the Toronto men who come to Welland to assist in starting the organization. The following is the list of building contractors who attended the meeting: W. J. Hickey, J. C. Diffin, E. Barrett, Horace Gray, Wm. Mitchell, Leslie Smith, Alfred Pettit, Chas. White, W. G. Somerville, James Hannell and F. S. Dilworth.

It was decided to hold another meeting on the evening of May 13, when the other branches of the trade would be invited to attend and directors elected.

Bridge Raised Thirteen Feet by Jacking

Four-Track, Double-Deck Steel Bridge and Approaches Elevated to Provide Extra Clearance Without Interruption of Traffic

ONE of the most original engineering accomplishments ever carried to successful completion is the lifting of about 7,800 tons of steel bridge truss spans and 7,150 tons of approach viaducts a maximum distance of $13\frac{1}{2}$ ft. with absolutely no interruption of the heaviest railroad traffic. On March 23, 1917, the U.S. War Dept. ordered that the Pittsburgh, Fort Wayne & Chicago Railroad bridge over the Allegheny River at Pittsburgh, Penn., consisting of five main river spans of four-truss, double-deck type and their approaches, be raised from a clearance line at El. 738 to a revised line at El. 750.6, and fixed the time limit for completion at one year from date. It was required that the lifting operation should be carried out between trains and proceed consecutively from pier to pier to prevent excessive grades.

pier were being kept at the same level during the raising operation.

After the completion of the raising, March 15, 1918, much other work had to be done on the bridges, such as the replacing of corroded angles in the upper level struts of the bracing and the placing of cast-iron protection plates above the lower-level tracks, and the introduction of diagonal longitudinal bracing in the approach viaducts on both ends of the bridge.

General Requirements

The Government order required a clear height 12.6 ft. greater than that furnished by the original structure. This involved the raising of the grade of the lower-level tracks at the ends of the longest span a distance of 12.47 ft. and 13.44 ft., respectively, the



Progress view and final appearance of Allegheny River bridge raised 13 feet to provide greater under clearance.

All the truss spans on any one pier were raised simultaneously by the use of hydraulic jacks of 100-, 200- or 500-ton capacity. The actual operations of lifting these spans, which were designed for six tracks and are the heaviest for their length in the country, were carried out in less than five months.

A very complete description of this piece of work appears in Engineering News-Record. From this article the following notes are made:

Restricted space and side-clearance limitations complicated the problem of placing new steel grillages on the main piers and providing support for the jacking girders. Furthermore, the approach girder spans and steel bents also had to be raised and the piers supporting these bents rebuilt by the addition of precast concrete blocks. In the Pittsburgh approach, where the side clearances were limited, spliced column extensions were added to the base of the steel column to give the necessary height. A simple device was installed to indicate whether the various spans at one

latter being the maximum lift required in the structure. The various lifts at the end and intermediate piers are given in the accompanying table, which also indicates the jacking loads at the piers, the length of spans and the dead weight of the spans.

The total length raised was 3,283 ft., which was divided into five operations, as follows: (1) Five main

Main Truss Spans and Weights—Distances Raised

Pier or Span No.	Span Centre to Center of Piers, Feet	Dead Weight of Span Tons	Total Jacking Load at Pier Tons	Distance Raised Feet
1	165.5	1199	602	10.47
2	337.5	3459	2331	12.47
3	160.9	1057	2258	13.44
4	160.9	1048	1048	13.19
5	160.5	1052	1048	12.53
6	.....	.....	528	11.26
Total	.....	7815	7815	

river spans supported by six piers, total length 987 ft.; each span is composed of four trusses of double-deck of pin-connected type on a skew, designed for three tracks on each deck, although only two tracks on each deck have been placed; (2) Pittsburgh approach viaduct of 25 half-through plate-girder spans supported on steel column bents, the total length being 823 ft., weight, 4,000 tons; (3) The Duquesne Way viaduct, 24 spans of which were raised, covering a total length of 1,230 ft. weight 2,350 tons. This is a double-track-deck plate-girder viaduct supported on steel columns; (4) Alleghany approach viaduct, composed of five half-through plate-girder spans, double track, on steel columns, length 177 ft., weight, 800 tons; and (5) Penn

being made up in depth of ties, some ties as deep as 20 in. being required.

History of the Operations

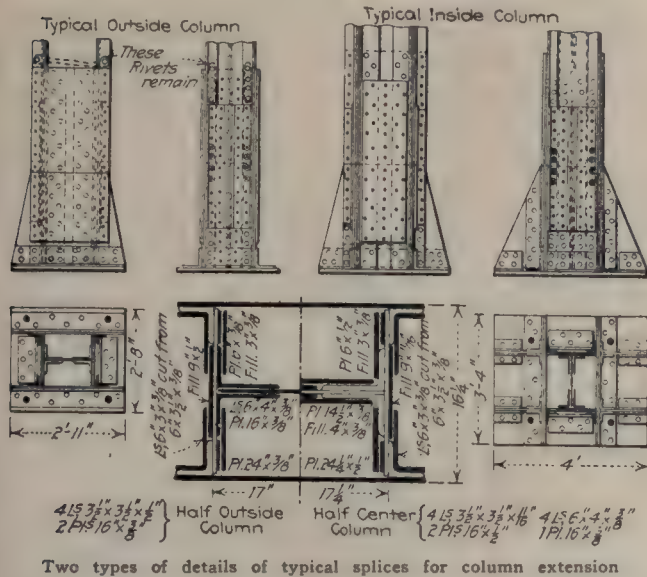
The work was let on a percentage basis, and as many new requirements were discovered the added work extended the time of the final completion of the contract nearly one year longer than that required to raise the bridge to its new level. Preliminary work on the approaches was started June 7, 1917, and all extra work on the main spans and approaches was completed March 15, 1919. The lifting of the main spans and the Alleghany approaches began October 30, 1917, and the last lift was completed March 23. The average lift on the main piers was 3 in. at first, increasing to about 6 in. per day, the maximum, accomplished February 25, 1919, being one foot three inches.

Work on the Pittsburgh approach began Aug. 11, 1917, and was finished March 11, 1918, the work being carried on simultaneously throughout the structure with a force that averaged about 75 men. The addition of splice material and reinforcement for corroded struts and floor-beams, the installation of new longitudinal bracing, and other additional work, kept the contractor on the work for another year.

Approach Columns Raised

The first work was the enlargement of the concrete piers supporting the columns of the approach bents to give sufficient width to support the jacks. Built-up steel brackets were bolted on two sides of the columns to support the dead weight. Beneath these the jacks were placed, the capacity of these jacks varying from 40 to 80 tons. For the heavier brackets eight 1 1/4-in. bolts were used at the lower end to take the tension, and wood blocks were inserted between the column angles at the top to take the compression.

The first operation was the placing of wood blocks for supporting the jacks, or, in case the precast blocks were finished, outside units were used under the jacks. The jacking up proceeded in 2-



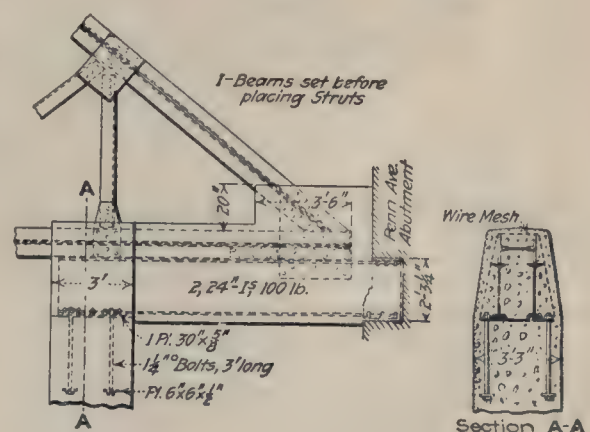
Two types of details of typical splices for column extension

Avenue bridge, which is a three-span half-through plate-girder bridge 60 ft. long, with steel columns at intermediate points.

Traffic Not Interfered With

In planning the operation non-interference with traffic was the most important point to be considered, so that all lifting equipment had to be designed to insure the most rapid lifting operations possible. No attempt was made to lift any part of the superstructure under live load. All of the superstructure resting upon any given pier had to be lifted at the same time and kept level during the operation, the distance lifted being limited by the fact that no grade exceeding 1 per cent was to be permitted during the progress of the work. In order to prevent undue strain of the riveted connections in the viaduct approaches, it was planned to raise the girders in consecutive sections of three spans, each lift to be limited to two or three inches.

As the interval between trains was seldom more than 15 minutes, a complete telephone system connecting the train dispatcher's office with those points in the field where the work was being carried on was installed. An elaborate chart was prepared to show when the track was required, how long, and when it would be released. During the work it was found necessary to allow 1.5 per cent. grade at various stages, and the final maximum grade is 1.28 per cent. on the Pittsburgh approach. The grade of the upper-level tracks was modified so that they were not lifted the same amount as the lower-level tracks, the difference



Special longitudinal bracing anchorage at abutment.

inch increments, using timber blocking under the column bases until the structure had been raised about 2 ft., when the centre precast block under the column base was inserted. The second tier of these blocks consisted of five units, the outside oblong blocks running in the opposite direction to those of the first tier. In placing this second tier, the first units placed were those under the jacks, the latter then being used to raise the columns by means of brackets in 3-in. lifts,

using timber blocking until the column was high enough for the insertion of the centre section under the column base. The outside sections could then be placed and the work proceed in similar order, tier by tier.

Extensions to Columns

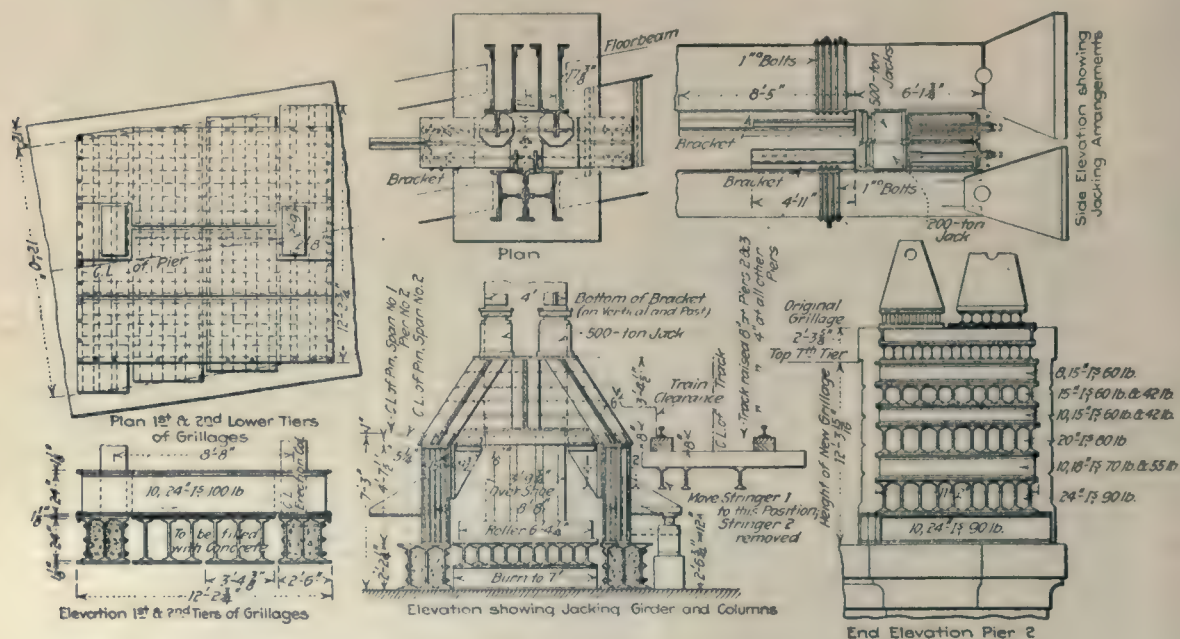
On account of insufficient lateral clearance for trains on the track under the viaduct, the concrete blocks on the Pittsburgh approach were brought up only to the level of the new ground line. The additional height necessary was provided by steel column extensions spliced to the old columns, as indicated on one of the drawings herewith showing the two general types—the inside column with central diaphragm, and an outside column of four angles and two web plates only, using new centre diaphragms at the splices. In placing the new extension, the dead weight and the live load were supported by timber struts from the ground to

were used, thus decreasing the number of points of connection between the new diagonals and the columns.

Jacking Up Main Trusses

The eight truss bearings at each intermediate pier were lifted at the same time, keeping all trusses at the same elevation in order to prevent undue strain on the rigidly connected floor-beams and portal bracing. The scheme finally adopted to allow rapid and continuous jacking operations is indicated by the diagram herewith. The problem was to design the jacking girders and steel grillage units to avoid interference and to keep outside of the train-clearance line. New steel brackets were bolted to the vertical end posts of the main trusses, below which the 500-ton hydraulic jacks could be placed upon jacking girders. These girders were carried by jacking columns built up of I-beams and placed in openings left in the grillage units.

It was first necessary to raise the railroad track 8



Jacking girders and columns with I-beam grillages Satisfy clearance requirements—pier No. 2.

the girders, one on each side of the column, each composed of three 12 x 12-in. timbers resting on timber cribbing drift-bolted to fit. After thus supporting the superstructure, the old column bases were removed by cutting out the rivets, new holes were drilled, the column extensions were inserted, and the splice material was added.

As the original structure was constructed with a level grade, the introduction of the grades on the approaches made it necessary to add new longitudinal bracing between columns in certain bays. On the Pittsburgh approach this bracing was introduced in five bays at various parts of the structure, always being placed in a fixed span. Double diagonals were used in all cases except in the end bay, where a special detail was necessary to connect to the abutment because of the presence of an electric-wire conduit running along the abutment. Details of this concrete-covered steel beam construction to span the conduit and connect to the abutment are indicated in one of the accompanying drawings. In the other approaches, single diagonals with a subdiagonal and vertical at the centre to shorten the unsupported length of the strut

in. to increase the clearance. The ends of the old I-beam grillages were burned off in order to allow the outside units of I-beams filled with concrete to be placed. These outside units, which had to carry the complete dead load on the jacks, were built up of I-beams bolted together before the concrete filling was placed.

The posts and jacking girders were then erected and the old truss grillages were bolted to the shoes, and jacking proceeded, using 3-in. timber blocking under the old grillages until the trusses were high enough for the insertion of the central unit of the first tier of new grillage. As the 500-ton jacks only had an 8-in. stroke, the clearance between the jacking girders and the truss shoes only permitted an 8-in. raise, and it was necessary to raise these jacking girders every time the bridge was raised 8 in. The dead load of the jacks, jacking girders and supports was about six tons, hence a set of auxiliary jacks was installed to raise the jacking girders by brackets, as indicated on the sketch, to allow rail grillages to be slipped under the jacking columns. These rail grillages were later replaced by I-beam stools. All of these operations, of

course, had to be carried on simultaneously at each of the four truss points on a given pier. After the operations had become familiar, it was possible to carry through one complete cycle for a 4-in. raise and place the 3-in. plank in four minutes.

Special Device Insured the Constant Level

A simple hydraulic device was designed, on the principle of water seeking its own level, to indicate when the truss bearings were not at the same relative elevation during the operation of lifting. A $\frac{3}{4}$ -in. pipe was placed below the floor of the span, and risers with glass indicator tubes were placed at each truss. Water with coloring matter was inserted, and the level indicated by placing a rubber band around the glass tube at the beginning of the lift.

All that the men who were operating the inlet valves of the hydraulic jacks had to do was to watch carefully to see that the water in the glass tube was kept constantly at the level shown by the rubber-band indicator. After some practice this could be successfully accomplished with less than $\frac{1}{8}$ -in. variation.

The hydraulic jacks were operated from a single steam pump placed on a platform carried by cantilever supports on the north side of span No. 2. The main line of $1\frac{1}{2}$ -in. pipe extended the full length of the five bridge spans and connected to 1-in. pipes running parallel to each pier, to which copper pipe was attached and connected through the supply valve with each jack on the various piers. These valves were operated by capstans above the floor of the bridge. Stop valves were placed on each side of the connection between the pump and the longitudinal $1\frac{1}{2}$ -in. pipe, also just beyond each pier, in order to govern the flow of the water to any set of jacks on any pier desired. A discharge valve was also placed at the connection for the copper supply pipe for each set of jacks, allowing the mixture of water and 50 per cent. alcohol used in the winter to be saved by catching it in buckets and returning to the pump.

Placing Steel Grillages

Timber platforms were hung from the trusses on each side of the main piers at a level just high enough to allow the steel grillages to be rolled into place on pipe rollers. Platforms on both sides of the pier were required because grillage units of alternate tiers had to be made double, each half being placed from opposite sides of the pier to allow space for the jacking columns. In order to avoid delay in obtaining material it was found necessary to use I-beams for these grillages from whatever source was available. For example, 15-in. I-beams from the old Louisville bridge were obtained and many other beams were furnished by the railroad. The height of the last tier was fixed by the required total lift at the given pier. These grillage units were fabricated at the site, using as cover plates the old Quebec bridge hangers which had been utilized in lifting the suspended span. These were $1\frac{1}{8}$ in. thick for those from the old span which was lost in the river, and $1\frac{1}{2}$ in. thick for the hangers last used.

The mortar beds between the grillage tiers made up about $4\frac{1}{2}$ in. of the varying difference between the net height of the steel and the height of the concrete encasement forming new caps for the piers. The concrete encasement was carried up to the top of the seventh tier; the concrete was placed by first filling the I-beam grillages with 1:3:6 gravel concrete, then placing the heart, $10\frac{1}{2}$ ft. wide between the grillages, of the same mix. The outside width of 13 ft. was then

made up by 1:2:4 mix, using gravel screened to $\frac{3}{4}$ in. and working the mortar against the forms so that no stone would show after the base was rubbed.

Vetrical joints were made to prevent the development of cracks in the concrete at the corner of the steel grillages where it joined the large mass of heart concrete, by using a steel plate nailed to the forms in a narrow V shape, this plate being removed with the forms and the opening pointed up after the concrete had set. The horizontal construction joints were made at any coursing joint, the latter being formed by triangular nailing strips spaced about 2 ft. $6\frac{1}{2}$ in. apart vertically. The care used in the location of the construction joints has resulted in the fact that no crack whatever has appeared, although several months have elapsed since the work was completed.

Repairing Corroded Struts and Floor-Beams

The locomotive gases and blast were found to have caused very severe loss in section of the transverse struts and floor-beams on the upper level above the floor tracks. It was therefore found necessary to replace the 4 x 4-in. angles of the struts by splicing in new sections in both flanges, usually 3 to 4 ft. long, and spliced by $3\frac{1}{2}$ x $3\frac{1}{2}$ x $7/16$ -in. angles. In some cases plates $10\frac{3}{8}$ x $\frac{3}{8}$ in., about 5 ft. long, were riveted to the lower strut angles. Cast-iron protection plates to prevent future corrosion were bolted to the bottom of these struts in the upper deck throughout the length of the bridge. The crowded floor-beams were rebuilt by adding web plates to both sides of the old webs and reinforcing the lower flange angles.

The estimate of the cost (made April, 1917) was \$500,000, but owing to the increase in the costs of all kinds of labor and material during the progress of the work, and loss in efficiency due to the unusually severe cold of the winter of 1917-18, the final cost was from \$750,000 to \$800,000. The exact cost is not known, as accounts are not yet closed.

Professor Charles S. Slichter of Maison, Wis., recently sent a letter to Judge H. A. Robson, congratulating the City of Winnipeg on its new Shoal Lake water supply. Professor Slichter was the man who first officially recommended this source of supply to Judge Robson in a report prepared in 1912. Judge Robson, at that time, was Public Utilities Commissioner. In this letter Prof. Slichter claims that Winnipeg has as magnificent a supply of water as any city on this continent or abroad. He lauds the softness and purity of the supply and questions the rumors that the water is unsanitary. Winnipeg's new water is claimed, in this letter, to be free from contamination and of such quality as to appreciably reduce many diseases attributed to unsanitary supplies. It is Professor Slichter's opinion that mechanical filtration will not have to be resorted to, careful watching of the strainers and a little care at the reservoir being all that is necessary.

The Chicago Bridge & Iron Company has changed its sales office address from 1305 West 105th Street, Chicago, to 2104 Old Colony Bldg. The general sales office has been removed from the works and is now situated in the Old Colony Bldg.

The Montreal Civic Administration have adopted a new schedule of minimum rates to be paid by contractors doing work for the city.

The Use of Cinder Concrete in Structural Work

By Harry Gardner

PROGRESS in any branch of engineering is the result often of practice rather than of theoretical experimentation. Purely theoretical considerations may indicate the fact that certain projects are feasible, are even economical; but, until practical proofs of such feasibility or economy are demonstrated, the projects often are postponed or are entirely dismissed from consideration. These remarks are not intended to detract in any respect from the value of purely theoretical deductions. Theory was never a more potent factor in the matter of progress than it is at the present, was never more thoroughly respected than it is at present. The fact remains, however, that, until practical considerations prove that a venture is feasible, theoretical considerations are not likely to be accepted as a basis for private venturing.

The matter of the feasibility of cinder concrete is a case in point.

Cinder Concrete Desirable in Certain Instances.

Tests have indicated for many years that certain characteristics of cinder make it desirable as a building material for certain classes of structure. Its use, however, in other than sidewalk construction has been restricted. Because custom has decreed stone or gravel as an aggregate in concrete to be used in structural work, builders specify usually stone or gravel for that kind of work. They make their specifications for stone or gravel, notwithstanding the fact that cinders might serve the purpose of aggregate with greater advantage than stone or gravel might serve it. They are not to be censured for their choice of aggregate, since experience has proved the fact that stone and gravel are desirable material to use as aggregate—that they produce concrete that is safe. Theoretical and practical considerations indicate the fact, however, that they might specify cinders safely and economically instead of stone or gravel for the concrete of certain kinds of structural work, notably for concrete work in steel skeleton buildings.

The indiscriminate selection of any particular kind of aggregate for concrete for all purposes, not only is famous, but even is to be deprecated. Aggregate, like all other structural material, should be selected with a view to suitability. Stone should not be selected, generally, for aggregate in localities in which suitable gravel is plentiful, nor should gravel be selected in localities in which suitable stone is plentiful. Similarly, neither stone nor gravel should be selected in localities in which suitable cinders are plentiful unless, for some reason, the selection of cinders is considered to be inopportune. In any case in which an aggregate is selected, suitability of the aggregate for the purpose for which the concrete is to be used should govern the selection.

Safety and Cost Govern Type of Aggregate

Many factors must be considered in determining the suitability of aggregate. Of these factors, safety and cost are perhaps the most important. The safety of a structure in which concrete is to be incorporated should be guaranteed irrespective of other considerations. Cost should be considered only after the safety

factor has been disposed of satisfactorily, although the matter of economy is becoming more and more important. Since millions of tons of cinders are wasted annually, their utilization as aggregate is a matter of importance in the way of conservation. Moreover, the cost of stone and gravel is increasing rapidly.

The fact that cinder aggregate will produce concrete that is not only inexpensive, but it also adequately safe for many classes of structures, seems not to be comprehended by many builders. The old idea to the effect that cinder concrete is unsafe, because it is weaker than stone or gravel concrete, and that the sulphur and other products of combustion in cinder concrete initiate corrosion of the reinforcing material still persists, although there is an abundance of data to refute the idea. The fact that steel embedded in cinder concrete containing considerable sulphur does not corrode if the concrete is properly proportioned and mixed has been proven. There may be, there probably are, instances in which unusual strength requirements, abundance of stone or gravel, absence of cinders, or some other factor will make the use of cinders for aggregate inadvisable. There are, on the other hand, many instances in which all factors, strength, cost, kind of construction, weight, etc., make the use of cinders advisable. The advantages and disadvantages of the different kinds of aggregate should be balanced against one another before a choice of aggregate is made.

Cinder Concrete Widely Applied

Several instances in which the use of cinder concrete has been adopted recently with successful results may be cited. These instances include examples of mass, or gravity, structures, reinforced structures, and stucco work. Some recent examples of the use of reinforced cinder concrete in structural work are represented by the Edison Storage Battery, 3-storey building situated at 247 West 35th, and by the Baker-Williams, 10-storey building situated at Leroy and Greenwich streets, New York.

The feature of these structures is that the reinforced floors are of cinder concrete. The floor panels of the Edison building, which are 22 by 28 ft. wide by 10 in. thick, are designed to support 150 lb. per sq. ft. of floor area. The panels of the Baker-Williams building, which are 19 by 21 ft. wide by 8 in. thick, are designed to support 400 lb. per sq. ft. on the first floor, and 250 lb. per sq. ft. on the upper floors. The floors in both buildings are reinforced by Clinton electrically-welded, wire cloth, and the Chew system of electrically-welded, octagonal steel mattresses. Both buildings are of skeleton steel construction, a type of construction to which reinforced cinder concrete floors are admirably adaptable.

Cinder concrete in Switzerland is used in reinforced work generally by some engineers. A particular instance is that represented by a concern which specializes in reinforced cinder concrete beam work. All beams cast by that concern are subjected to loading tests before they are incorporated in buildings, although very few rejections of unsatisfactory specimens have occurred. The use of reinforced cinder concrete in that country is proving to be entirely satisfactory, according to the observations of Albert Oliver, of New York, who has investigated the matter.

Experience Proves Its Feasibility

That the use of cinder concrete in structural and stucco work will become more general than it has been heretofore is to be expected, since experience

as well as theory indicate that its use in such work is entirely feasible and economical.

The argument that cinder concrete is too weak for structural work or that it corrodes reinforcing material is rebutted by the facts that it is being used at present in structural work with entire satisfaction, and that steel bars which have been removed from cinder concrete beams after several years' embedment have not been corroded in any respect.

In addition to the foregoing cinder concrete is light. The weight factor is important since it minimizes the floor loads to be accommodated in structural work, and it prevents excessive weight of structures receiving plaster coats and stucco. The use of cinders in plaster and stucco coats is advisable in many instances, because the cinders are not as heavy as other kinds of aggregate, and because plaster and stucco are not intended to sustain superimposed loads.

Precautions to be Observed

The use of cinders for aggregate intended for whatever purpose involves no principles or operations that are not involved in the use of other material as aggregate. The principal precautions to be observed are to screen all ash from the cinders and to mix thoroughly the concrete containing the cinders. The presence of voids need not occur in concrete containing cinders any more than in concrete containing any other kind of aggregate. As a matter of fact, the presence of voids in concrete containing any kind of aggregate whatever reflects rather upon the competency of the man who produces the concrete than upon the material incorporated in it. The successful use of cinders as aggregate for concrete in structural and stucco work is nothing more than a practical application of a common-sense principle, a principle which theory alone has long suggested to be feasible. Now that engineers and contractors have precedents on which to rely, valid reasons exist for a more extended use of cinders for aggregate.

The above article is reprinted from Engineering World.

Cost-Plus Contract Incentive to Close Management

IS there a greater incentive to good construction management in the cost-plus contract than in the lump-sum contract? Discussing this question in Engineering News-Record, Morton C. Tuttle, of the Aberthaw Construction Co., developed a line of thought which, though possibly not new, will repay attention by contractors. For the concern performing the whole or a large part of its work on a cost-and-profit basis, there is, asserted Mr. Tuttle, a tremendous incentive to satisfy each engineer or owner for whom work is done. Mr. Tuttle further stated:

It is clear that the anxiety which a contractor feels for his own financial interests may vary greatly as between a lump-sum and a day-work contract. If he is satisfied to do one job for one customer and to leave that customer dissatisfied, he undoubtedly has a chance on a cost-plus contract to pile up cost, and short of provable negligence, will be reimbursed for all expenses incurred. At the end of the job he will receive the agreed profit and will be left with an impaired good-will. A few repetitions of this situation

should remove him completely from the field of cost-plus work. It is inconceivable that large jobs will be placed with any contractor until after his references have been thoroughly looked up.

One dissatisfied customer will prevent a great deal of future profit. In one case which has received rather wide publicity a dissatisfied customer had a considerable part in ultimately bankrupting a once prominent building concern.

Builds up a Clientele

It is apparently not clearly understood in the building trade that a reputation for carrying on honestly and successfully—and, above all things, economically—a cost-and-profit business leads to the establishment of a clientele of customers who turn all their work to a concern which has once satisfied them. In the case of my own company 58 per cent. of our business in the past five years has come from concerns for which we have worked before, and very commonly we do all building work for many of these customers. Had our business been done on a bid basis we should have earned with each of these customers simply a chance to bid again. To establish business relationships as intimate as this, leads necessarily to vigilance as to each detail of every operation. A concern carrying on cost-and-profit work primarily must be honest, and it must have vision enough to understand the necessity of carrying on its work satisfactorily to each and every engineer and owner. It is so easy to start a reputation for extravagance, for inefficiency or for careless workmanship that vigilance has to be exercised at all times. To allow slackness on any one job, or to allow higher costs than are justifiable, would be suicide.

The two types of contract are really difficult of comparison. Under the percentage form of contract it will be assumed that the engineer or architect has specified exactly what he wants and is entitled to exactly that which he has described. Under the lump-sum form of contract an attempt is commonly made to see how far it is possible to depart from the more expensive items specified. The questions of allowances and extras are always troublesome and generally are not frankly handled. With the lump-sum contract there is a tendency to give less thought to the quality of the work and more thought to the first cost—a procedure which shows up later in the cost of upkeep. With the lump-sum contract there is less co-operation between the engineer and the builder, a condition which has again and again resulted in needless expense, loss and faulty workmanship.

That the quality of work should be better under the cost-plus form of contract is undoubted. As to cost, it would be interesting to see a tabulation showing the bid prices and the final costs of, say, twenty-five jobs. Very commonly the original bid and the final cost would not be recognizable as applying to the same work.

No Perfect Lump-Sum Contract

Some day, so close to the millennium that the question of building shelters may be neglected, some engineer or some architect will make an absolutely clear set of plans and specifications which will describe accurately some big job from start to finish. Then he will invite a limited number of perfectly honest and perfectly competent contractors to make independent and honest estimates, each estimate to contain a reasonable item of profit, and with these

estimates will come an honest statement of the length of time each of these contractors will require to carry out that work. Under these conditions, we shall all agree, the lump-sum contract is a most excellent thing because an honorable concern has employed an infallible engineer and architect to describe exactly what it will require and an honest and able contractor has agreed to furnish these things, and has assured himself of reasonable profit for furnishing them exactly without substitution.

Until this combination is secured there will be a good chance to argue with any owner that he is more likely to get what he wants in the time in which he wants it by some arrangement which secures the co-operation of his contractor with his engineer, with the assurance on the part of both that they will be reasonably compensated for the work that they do.

Efficient Labor Due to Efficient Supervision

The common explanation of any slackness of labor on a cost-plus job is that the laborers know that their employer's interest will not suffer if they loaf upon that particular job. To anyone familiar with the building trade, how much anxiety labor feels toward the financial interests of its employer is a subject for profound speculation.

As to the performance of the labor under the two forms of contract, it seems reasonable to suppose it will produce the most economical and satisfactory results on the job where it is best directed and best led, regardless of the contract arrangements.

Ice Breakers on St. Francis River

THE Public Works Department, Ottawa, have called for tenders, for the construction of three icebreakers on the St. Francis River, at Richmond, P.Q. These consist of three solid closed-faced stone-filled timber crib ice breakers, 28 ft. by 18 ft. at the bottom, and 24 ft. high, the faces being vertical throughout the whole height of the pier, except at the end facing the current, which will have an inclination of 30 degrees, 30 feet with the horizontal. The two sides of the sloping face will be protected by steel plate sheathing. The cribs will be filled with boulders of 6 in. to two feet diameter. The face timbers are to be 10 x 10 in. square, bolted with 7/8 in. drift bolts; the cross ties, the longitudinals, and the vertical posts are to be 10 x 10 in. square. The lower section of each face of the ice-breakers will be sheathed with 4-in. spruce pile planks, driven closely together at the bottom of the river, and bolted with spikes 12 in. long, while the sloping faces will be sheathed with 8 in. tamarac or rock elm timber bolted to the face timber or the bevelled stringers. The angles formed by the slope face with the side 8 in. sheathing will be covered with 1/4 in. steel plates.

Provincial Ministers to Discuss Federal Aid

DURING the Good Roads Convention at Quebec City on May 22, a meeting will be held by Provincial Ministers to discuss the question of Federal aid to highway construction, particularly in connection with the allocation of the proposed grant of twenty million dollars. Among those expected are the Hon. A. Veniot, Minister of Highways, New Brunswick; the Hon. Sam Latta, Minister of Public Works and Highways, Saskatchewan; the Hon. George A. Grierson, Minister of Public Works, Manitoba; the Hon. J. A. McNeil, Commis-

sioner of Public Works, Prince Edward Island; the Hon. Findlay MacDiarmid, Minister of Highways, Ontario; the Hon. J. A. Tessier, Minister of Roads, Quebec, with probably the Highway Ministers from Nova Scotia and Alberta. A conference will afterwards be held with the Hon. J. D. Reid, Federal Minister of Highways, Railways and Canals, who is coming from Ottawa for the purpose of speaking on the subject.

Letter to the Editor

Toronto, May 1st, 1919.

Dear Sir:—

You are hereby notified that the Annual General meeting of the Canadian Manufacturers' Association for 1919 will be held in the King Edward Hotel, Toronto, on June 10th, 11th and 12th next. Business will commence at 10.30 a.m. on June 10th.

I earnestly hope that you will make a special effort to attend in order to give the Association the benefit of your co-operation and advice in solving the difficult problems which are now confronting the manufacturers of this country.

The Association is now entering what may be described as the third period of its history. During the first period, from 1872 to 1899, its activities were provincial and its membership limited to about 300. During the second period, from 1899, when it was organized as a National Association to the signing of the armistice, the membership increased from about 300 to nearly 3,500, and branches were organized from coast to coast. The second period saw a great growth of manufacturing. The present period, beginning with the signing of the armistice, will be the period of readjustment from war to peace conditions, the continued and rapid development of Canada as a nation, and I hope and believe, a corresponding development in the activities of the Association and in the increase of its membership.

Three of the most important matters for discussion at the Annual Meeting are (1) the readjustment of the existing relations between employers and employees, (2) the revision of the tariff and (3) the development of export trade. In addition, there will be reports of the various committees which, during the past year, have dealt with an unusually large number of subjects of vital importance to Canadian manufacturers. It is from the views and decisions of the members present at the Annual Meeting that the policy of the Association for the coming year is largely shaped.

The programme outlining the business to be transacted will be mailed to you in due course. I appeal to you to make a special effort to be present.

Anticipating the pleasure of meeting you in Toronto on the above dates, I remain,

Yours faithfully,

W. J. Bulman,

President.

Overhead in Contracting

THE more work you do the less your overhead is. On the little fellow the overhead is sometimes as high as fifty per cent. The more efficient your organization is the less your overhead is going to amount to because leaks are all discovered. The question often arises as to what constitutes overhead. In many instances important items are omitted.

We are all getting to realize that we must add a certain amount for advertising. We are going to do an awful lot of advertising along co-operative lines. So I will start out with "Advertising." In order to run a good regulated business, you have some pictures taken to show your jobs. That is another item of overhead. Make that a big item, and the more jobs you will sell.

Then there is the office rent, and office help. There is office equipment used up in operating throughout the year. There is the telephone. There is a liability which really should be charged directly into the job. I for one, charge it directly into the job; and those men who don't have to, figure it into their overhead—that is, the smaller contractors.

Then there is your rental: That is a big thing, and will be a bigger thing for those men who will remain in the business. I believe their yards will be more fully equipped as we go along, because the other man will go out of business as he won't be able to stand the pace.

Then there is our insurance and maintenance of automobiles. I don't mean any trucking that is charged direct to the job, but all these automobiles which you have to maintain to go around to the jobs. That is quite an item of overhead.

Repairs and Small Tools

Repairs you cannot absolutely get away from. You cannot charge them into any job directly. They get there before you know it. You must figure also your depreciation. Your trade doesn't allow you enough depreciation, anyway, especially if you are in the concrete business, where depreciation is awfully high, unless you have some very efficient help. Then there is the item of small tools; and even if you charge a certain amount, I think you should have a small tool account which you carry throughout the entire year, in order to find out where you really stand.

In addition to all these, there is charity. Didn't we all come across this year for charity? In spite of the fact that we were not doing very much, our committees always ran ahead; and whenever they had a banquet to celebrate the victorious drives you just bet on it that the builders came in there. There is an overhead again. It is a part of your business expense, but how many of you are charging it to that source? For the real small contractor it is an item which is too big for him to forget. He must figure it in his overhead and spread it over his entire year, because it must go in somewhere.

Charges for Literature

Then there are your books. Every man should have a report of his different associations; and if they don't have the reports, see to it that the next convention gets one out and gets it printed. We need these books. We get a lot of good out of them. Those items

must be charged in your overhead, because a book is only current.

There are also magazines. I believe that is another item. We have got a pretty big item for this expense. The current magazines must be read for your best interests.

Then there are legal expenses; that is, expenses for legal services; some contractors have big items of expense in this way. They have had a lot of difficulty in collecting their accounts. If they had a better system to follow, perhaps they would not have that expense.

There is interest on your investment. You certainly must figure that in your overhead. There is also profit and loss.

Salaries

And last, but not least, don't forget that in a good business as a salaried officer you are entitled to draw a salary from it for your work. Don't close your eyes and find out finally that the men have gotten all the money and have left you nothing but worry. Don't forget to include your salary and any additional salaries in your overhead.

[The above is an extract of an address delivered by W. F. Tubesing, Milwaukee, before the Eighth Annual Convention of the National Association of Builders' Exchanges.]

Progress of Farms Depends on Development of Highways

A GREAT deal of emphasis should be laid upon the development of highways in farming districts as farms are being sold on the basis of road development and rural motor express, stated Andrew H. Phelps, in an address to the American Road Builders' Association, at their recent convention. The "back to the land" movement is a step in the right direction. However, until farms are connected with the most modern transportation by the motor trucks and good roads this movement cannot progress as rapidly as it might.

The three distinct branches of industry on this continent are manufacturing, mining and farming. None of these has been developed to what we might consider half the maximum. The industrial and mining development has been most marked during the period of the war. Agriculture has had a pronounced advance, but not in proportion to the other two groups. One of the greatest problems of the future and of the reconstruction period is the feeding of the world. With the devastation of large areas that, prior to the war, were productive of much foodstuffs, and the tremendous loss of man power caused by the war, the problem of feeding the world is of first magnitude. In order to bring a greater movement in developing farms and raising agricultural products, co-operative effort should be encouraged and the farmer urged to avail himself of co-operative markets. The farmer has experienced difficulty in securing labor during the last two years, while men were few and wages high for a minimum number of hours. Few farmers have the necessary capital to purchase modern agricultural implements; the returns to those who are using antiquated methods are so meagre in comparison to those employed in industrial pursuits that there has been in some parts of the country a wholesome desertion of farms. Much can be said about the fine work the government is doing in educating the practical farmer in scientific methods of agriculture. Edu-

cational institutions are training young men in agriculture so that they have a knowledge of scientific methods bringing about big results in farming and developing an esprit de corps among farmers. These things are all very well, but roads are essential, and the new type of farmer will not permit muddy and ill-kept roads, but will insist upon better local, state and national highways.

Wharf Improvements at Magog, P.Q.

The Federal Government is about to carry out some work at the wharf at Magog, P.Q. This involves the tearing down of the present approach and head-block, consisting of a pier fixed on piles, and the construction around the present pile wharf of a closed faced stone filled crib 15 ft. wide at the bottom by 10 ft. at the top, having 54 ft. of outer surface, 125 ft. 10 in. on the west side, and 119 ft. 6 in. on the east side. A low landing stage, 4 ft. wide, for small boats will be constructed on the east and west sides. The crib flooring is to be built as the foundation for a waiting room, shelter closed at both ends and open in the centre, and freight shed. All these will be under one roof. The structure will be of frame construction, with pine ceiling, and roof of asbestos shingles. The work is to be done in two sections, and must not interfere with navigation.

Safety Leagues Inaugurate Contest

The Canadian National Safety League and the Ontario Safety League jointly announce a cartoon contest in connection with accident and fire prevention work in Canada. The purpose is to secure drawings that will best promote a wider interest in safety work, in factories, shops, homes, schools, or on the streets, featuring men, women or children in accidents or near-accidents. A prize of fifty dollars will be awarded for the winning drawing and special prizes of five dollars each will be given for every drawing accepted. The contest is open to all artists in Canada, and any number of drawings may be submitted. Drawings must be in black and white and suitable for two column line reproduction. All drawings are to be submitted to the General Manager, Ontario Safety League, Royal Bank Building, Toronto, Ontario, by June 30th, 1919. A committee appointed from the Executive Committee will act as judges.

Industrial Relations Commission to Hear Montreal Contractors

The Association of Montreal Building and Construction Industries will be represented before the Royal Commission on Industrial Relations when evidence is taken in Montreal, and a special meeting is to be held to arrange for the views of the sections and sub-sections to be authoritatively presented. The directors of the Association, at their last meeting, expressed regret that no action, beyond the appointment of the Housing Commission, has been taken in the matter of industrial housing in the city, especially in view of the shortage of houses. The secretary reported that with the object of organizing the plastering contractors of the city and district of Montreal, and having them fully associated with the Association, three successful meetings had been held lately.

Tenders on Regina Building

The bids on the winter fair building, Regina, Sask., for which the contract has been awarded to Smith Bros. & Wilson, were as follows:

	General Plastering Ceiling Partitions			
Wilson and Wilson	\$97,500	\$1,980	\$8,500	\$ 400
Pool Construction Co.	95,775	1,756	7,800	1,190
City of Regina	87,976	1,596	7,485	1,190
Smith Bros. and Wilson	87,000	1,584	8,404	598

The tender of Smith Bros. & Wilson was accepted for all the work except the ceiling, which is to be done by day labor, making their total price \$89,182.

Stone Corporation Opens Toronto Office

The Canadian Crushed Stone Corporation, Ltd., of Dundas, Ont., have opened a Toronto office at 409 McKinnon Building, with Capt. J. Ridley Wylie as their representative. The company intend to push the sale of their product aggressively for road construction and concrete work. Capt. Wylie changed khaki for civies last December. He enlisted in 1915 and returned from overseas in December, 1917, but for the year following was retained for military duty in Hamilton. A good sportsman is generally a good business man, and Capt. Wylie has been an active and successful participant in all kinds of sports and is very well known in sporting circles.

Alberta's Expenditures on Public Works

At the recent session of the Alberta Legislature there was voted for expenditure on the highways, including bridges and ferries, a total sum of \$1,400,000.00. The votes in connection with the public buildings included \$267,500.00 for new construction in connection with the Hospital for the Insane at Ponoka; \$150,000.00 for a new court house at Medicine Hat; \$250,000.00 for new schools of agriculture, and \$200,000.00 for the Tubercular Hospital at Bowness, besides other small items.

At a meeting of the Montreal Council it was suggested that the City Commissioners issue instructions that, in every case where tenders are asked for, the specifications and all other documents relating to it be drafted in both languages. The suggestion was made to avoid the repetition of what occurred in the tenders for the reconstruction of the Lapointe-Letourneau bath, where tenders were refused because the specifications were in one language.

Trade Incorporations

Regent Metal Goods, Ltd., head office Montreal, capital \$75,000.

Ottawa Iron & Metal Co., Ltd., head office Ottawa, capital \$50,000.

Ontario Contracting Co., Ltd., head office Toronto, capital \$40,000.

La Salle Hardware, Limited, head office at Lachine, P.Q., capital \$50,000.

Canadian Western Steel Corporation, Ltd., head office, Calgary, Alta., capital \$2,000,000.

Terrebonne Electric Power & Steel Co., head office at Terrebonne, P.Q., capital \$2,500,000.

W. E. Wood Company, Ltd., capital \$40,000, head office Walkerville, Ont. Authorized to carry on a building and contracting business.

Mainly Constructional

East and West—From Coast to Coast

Mr. Norris E. Gibb has recently completed 135 ft. of dock for the F. McGibbon & Sons Lumber Co., Ltd., Sarnia, Ont.

The Toronto Housing Act has received the approval of the city council and the Housing Commission have now got started on their work.

The council of Barton Township, Ont., has decided to adopt the government's housing scheme and a by-law to this effect is being put through.

A two-million-bushel addition to the Saskatchewan Co-operative Elevator Company's terminal elevator at Port Arthur, Ont., will be started next month.

The street and waterworks men in Perth, Ont., went out on strike recently, following a cut in wages from \$3.50 to \$3 per day. They demand the former rate of pay.

The Ottawa building trade strike has been settled, the men receiving an all-round increase in wages approximating 20 per cent., an eight-hour day and elimination of all overtime.

The C. P. R. wharf in New Westminster, B.C., will probably be extended to the harbor line this year, in alignment with the section of the water front improved by the city.

The 10-room school for which tenders have been received by the public school board of Regina, Sask., will be of reinforced concrete construction, faced with red or buff brick, 114 ft. x 68 ft. in plan.

The carpenters' union in Fredericton, N.B., are demanding an eight-hour day, with the same wages as for a nine-hour day, effective May 19. The minimum wage for the nine-hour day is \$4.50 per day.

A housing committee has been appointed in Newcastle, N.B., with the object of relieving the housing situation, which is very acute. New Brunswick's share of the Dominion Government housing loan is \$1,250,000.

It is reported that the Hudson's Bay Company propose erecting a \$2,000,000 building on Portage Ave., Winnipeg, and that extensions to their stores in Vancouver, Calgary and Edmonton, are also being considered.

There is considerable building activity at Peace River, Alta. Among the structures in course of erection are a warehouse, 26 x 50, a one-storey business block, 32 x 50, a new meat market and the McNamara Hotel.

Woodbridge, Ont., has decided to erect 25 houses under the Ontario Housing Act. Joseph J. Watson, W. J. Blake, W. S. Belfry, Dr. G. D. MacLean and Reeve C. L. Wallace are members of the local housing commission.

Three hundred lots have been purchased at Rosedale, Alta., from William Robertson, of the Calgary Clothing Store, by I. B. Hewer & Co., a local real estate firm. It is proposed to build 100 houses on the holdings at an approximate cost of \$2,500 each.

Building permits were issued in Regina, Sask., during the month of April to the value of \$187,480, as compared with \$29,310 for the same month last year. The largest building included is a warehouse which is being built by Albert Olsen, costing \$50,000.

A deputation from Haliburton, Ont., recently interviewed members of the cabinet at Ottawa regarding the

construction of a new dam at Drag Lake, in order to conserve the water supply for the industries of the village. The present dam is said to be unsafe.

The painters' strike in the city of Toronto has been settled. The Provincial Government, the civic authorities and the board of education, as well as 57 of the principal painting and decorating firms in the city, have decided to pay the men the new rate of 65 cents per hour.

The steamship "Faith," the first large concrete vessel to be constructed, has been sold to the French American S.S. Line for \$450,000. This vessel, it will be remembered, was built in the United States as a war-time experiment, the original cost being \$900,000, and has been in service a year.

Thirty-nine building permits, valued at \$58,405, were issued in Kitchener, Ont., during the month of April. In the same month last year, the value of the permits was \$12,620. The total for the first four months of this year is \$182,545, as compared with \$31,615 for the corresponding period in 1918.

Mr. I. C. F. Knight, who was formerly chief engineer of the Canadian National Ry. System, with headquarters at Moncton, has now taken up new duties as superintendent of the company's new St. Malo shops in Quebec. These shops have not yet been completed, but probably will be by July.

Among the public works to be carried out in Northern Ontario by the provincial government are: a road from Elk Lake to Gowganda of tarviated macadam construction, to cost some \$250,000; macadam road from Swastika to Kirkland Lake. The construction of a steel bridge over the Matagami River is also being discussed.

The Ottawa building trades' strike has been settled and the men are back at work. Some of the larger contracts on which operations have been resumed are the Parliament Building, the Imperial Oil Company's building, the technical school on Albert Street, the Hunter building and the new civil re-establishment building on the corner of Vittoria and Bank Streets.

Among the new buildings which the Alberta Department of Public Works proposes to erect this year are: Hospital for Insane at Ponoka, \$267,500; court house, Medicine Hat, \$150,000; Institute of Technology, Calgary, \$200,000; home for mentally deficient children, \$100,000; schools of agriculture, \$250,000; province's share in tuberculosis hospital at Bowness, \$22,000.

The strike of 3,400 employees of the Canadian Car & Foundry Co. in Montreal has been settled. The agreement provides for a five-day week, with nine hours a day, and plans for closer co-operation between employers and employees by means of an industrial council within the company. Wages are fixed from 50 to 70 cents an hour, time and a half for overtime and double time for Sundays and holidays.

At 11 a.m. on Thursday, May 15, the general strike in Winnipeg, in sympathy with the building trades and metal workers, was called. Some 27,000 trade unionists left their work, street cars were taken to the barns, building elevators stopped running, postal employees went home, all deliveries of milk, bread and other foodstuffs ceased. About 3,000 clerks, bookkeepers and stenographers throughout the city also struck.

Hon. F. B. Carvell, Minister of Public Works, announced recently in the House of Commons that the cost of the new parliament building at Ottawa would reach \$8,000,000, instead of \$5,000,000 as originally estimated. The architects were to get 5½ per cent. on the five million dollars, and the contractors, eight per cent. on the first four

millions and seven per cent. on the fifth million. Both the architects and the contractors have already received this remuneration and from now on receive no further return on their work.

At a recent meeting of the Building Trades Council in Montreal, which was very largely attended, the following resolution was adopted: "We intend to honor the principle of organized labor as defined by the American Federation of Labor, and have no desire to take the advice of any person not interested in our welfare as to the proper manner in which to secure just wages and working conditions."

A deputation of the Associated Boards of Trade along the Lake Erie & Northern Railway recently had a conference with Acting Premier White and Hon. F. B. Carvell, Minister of Public Works, regarding harbor improvement work at Port Dover, Ont. It is urged that the government should undertake this work as soon as possible. Two schemes have been outlined by the engineers, one of dredging in-shore, and the other of building out to deep water, the cost is estimated at from \$50,000 to \$300,000.

Winnipeg Trades' Unionists have decided to erect a new Labor Temple, involving an expenditure of approximately \$500,000. Option has been secured on a property immediately in the rear of the Brunswick Hotel and almost opposite the central police station, having a frontage of 125 ft. on Rupert St. and the same on Pacific Avenue. The cost of this site will be \$53,125, and the construction work is estimated at \$325,000, and the interior fittings at \$75,000. It is proposed that this building should have an auditorium to accommodate 2,500 to 3,000 on the main floor.

The following wording has been decided upon by the Toronto Board of Education in their contract form: "That accepted tenderer be required to enter into and execute a contract with the board on the form prepared by the solicitor of the board for the performance of the terms of the tender, and also enter into a bond with two good and sufficient sureties, to be approved by the said solicitor, for due fulfillment thereof. On default of so doing the deposit made by the tenderer shall be forfeited to the board as provided by the by-laws."

In order to remove the present hesitancy in the undertaking of building work and get a start made in the industry, a Canadian lumber firm has adopted a novel plan of insuring the customer against any substantial decline in prices. In an open letter this firm states "we propose to give you insurance and propose to refund to the purchaser the full amount of the difference between the price paid us for his building material this spring and the new price next spring. You take no risk. If you put off building and prices go up, then you lose. If you put off building and prices go down you will save the difference but you will not have had the building during the year 1919. Here is your alternative, if you build now and take advantage of our offer, you will have your house during the remainder of the present year, and if prices go down you get the benefit of the lower prices just the same."

GOOD ROADS ACTIVITIES

It is estimated that 250,000 soldiers will find work on the United States highway programme this year.

The main roads of Prince Edward County, Ont., which are well known for their excellence, came through the winter in good condition.

The Ontario Department of Highways is sending to the Canadian Good Roads Congress at Quebec City thirty miniature models of highways.

A largely-attended meeting held in Tilbury, Ont., recently went on record favoring a permanent improved highway from Windsor, via Tilbury, to Chatham. Immediate

construction of this highway is also urged in a resolution sent to Premier Hearst and Hon. F. G. Macdormid, and also to municipal councils and trade organizations in Kent and Essex counties.

Gravelling on the Liverpool road from the Pacific Highway to the Liverpool cannery, in the municipality of Surrey, B.C., is being carried out by the Peterson Construction Co.

Work is now under way on the Hull-Montreal highway, under the direction of Mr. W. Lessard. It may take three seasons' work to convert the present mud roads into a permanent highway.

It is expected that work will be commenced this summer on the road from Hull, P.Q., to Maniwaki. Construction of a highway from Hull to Pontiac will also be urged upon the Minister of Highways.

It is understood that work is being commenced in British Columbia on the work of surveying the Cascade-Rossland link in the Transcontinental Highway, with T. C. Whittaker in charge.

The continued rains have had a very injurious effect upon the roads to Frontenac County, Ont., and it will cost several thousand dollars to put them into proper condition again. The amount appropriated by the county for road work this year is \$68,400.

The municipal authorities in Belleville, Ont., have come to the conclusion that macadam roadways are not strong enough to stand up under the action of present-day automobile traffic, and propose undertaking a programme of asphaltic concrete pavements.

It has been announced that the Ontario Government will grant an amount not to exceed \$30,000 for the construction of a motor road from Timmins through South Porcupine to the Dome Mines. This grant will be made on condition that the township of Tisdale shall contribute dollar for dollar to the cost of the road, which will be built at a total cost of about \$60,000.

The rainy spring season has left the roads of Hastings County, Ont., in the worst condition they have ever been in. This applies particularly to the side roads. The Stirling, Frankford, Tweed and Madoc roads are in fair condition, and the Trent road along the front of Hastings is in better shape, owing to the fact that some improvements were made upon it in preparation for paving as part of the Provincial Highway.

Personals

Mr. F. J. Spielman, of Spielman Agencies, Regd., Montreal, has been elected vice-president of the Association of British Manufacturers. The Montreal branch has 51 members and the Toronto branch 40.

Mr. James Powell has resigned the secretaryship of the Canadian Railway Club, Montreal, after 14 years' service. He retired from the Grand Trunk, and is now connected with the educational classes for the re-establishment of returned soldiers. Mr. Powell is succeeded by Mr. W. A. Booth, chief draughtsman of the Grand Trunk. Among the other officers elected are Mr. W. H. Winterowd, chief mechanical engineer, C.P.R., vice-president; Mr. C. H. N. Connell, division engineer, C.N.R., second vice-president.

Following the return of Capt. H. L. Fetherstonhaugh, M.C., from service overseas, the partnership of Fetherstonhaugh & McDougall, architects, temporarily dissolved during the war, has been resumed. The partners are Messrs. J. Cecil McDougall, B.Sc., B. Arch., A.R.I.B.A., and H. L. Fetherstonhaugh, B. Arch., A.R.I.B.A. Their office is in the Drummond Building, 511 St. Catherine St. West, Montreal.

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Chemical Society's Activities

Following the convention of the Canadian Society of Chemical Industry held in Montreal, it was decided to form a new society to be known as the Canadian Institute of Chemistry, which will co-operate with the Society of Chemical Industry. The following were elected as the executive committee of the Society of Chemical Industry: Dr. W. L. Goodwin, chairman; Mr. H. van der Linde, vice-chairman; Mr. Alfred Burton, hon. secretary. The council comprises Messrs. E. G. R. Ardagh, J. W. Bain, W. Lash Miller, W. H. Thom, M. L. Hersey, C. R. Hazen and T. H. Wardleworth.

The branch organizations are as follows:

Montreal branch: Mr. Robt. Job, chairman; Mr. Geo. D. McIntyre, secretary; committee, Messrs. I. Grageroff, P. H. Holland, C. R. Hazen and Reg. M. MacLean.

Toronto branch: Mr. E. G. R. Ardagh, chairman; Mr. L. T. Acton, secretary; committee, Messrs. J. W. Bain, M. L. Davies, H. E. Rothwell, C. F. Thurlow,

D. G. Buchanan (treasurer), H. van der Linde and L. E. Westman.

Ottawa branch: Mr. F. T. Shutt, chairman; Mr. S. J. Cook, secretary; committee, Messrs. A. E. MacRae, R. E. Gilmore, F. J. Hambly, E. Stansfield and M. F. Connor.

Minimum Wages for Montreal Workmen

The following is the list of minimum wages to be paid by contractors doing work for the city of Montreal: Bricklayers (sewers), 70 cents an hour; bricklayers, 60 cents; carpenters and joiners, 45-60 cents; cement finishers, 40-50 cents; electricians, 40-50 cents; engineers, 40 cents; licensed oilers, 35 cents; laborers (common), 30 cents; laborers (hod carriers), 35 cents; lathers (wood and metal), 40-45 cents; machinists, 50 cents; masons, 45-55 cents; plasterers, 50 cents; painters, 40-45 cents; plumbers, 45-55 cents; tile setters, 50-55 cents; sheet metal workers and roofers, 40-50 cents; steamfitters, 45-55 cents; stone cutters (marble, granite, limestone), 50c; blacksmiths, 45 cents; pavers, 48 cents; quarrymen, 40 cents; block setters, 48 cents; curb and flagstone setters, 45 cents; weighers, 35 cents; asphalt finishers, 45 cents; asphalt rakers, 50 cents; polishers, 40 cents; levellers (cement), 35 cents; roller (asphalt), 45 cents; big roller macadam, 40 cents; brushers, 32½ cents; bottom men (drains), 35-40 cents; carters (single vehicle), \$4, and carters (double vehicle), \$7.50 a day.

A New Form of Reinforcing Metal for Concrete

From Le Genie Civil

M. CHARLES RABUT, a retired inspector of the French bridges and roads, has recently presented a paper to the Academie des Sciences in which he proposes a new form of reinforcement of concrete, which consists in substituting thin flat or curved plates or tubes for the bars and rods now in use.

The present use of three courses about a given point is always superfluous as three tri-orthogonal tensions can be arranged in two perpendicular planes, one of which possesses only one degree of freedom; these two planes should therefore contain the two principal tensions, one of these being the largest of the three under consideration and the two other tangential to a third virtual course, so as to form an ideal reinforcement by means of a system of triple orthogonal surfaces, especially as each of the three courses may be real in some areas and virtual in others, according to the position of the external forces.

In a structure where the three principal forces are tensile it is desirable to combine a course of bars with a plate, each point in the combination being so fixed that the bars are placed in accordance with one of the principal tensions and the plate in accordance with the two others.

Advantage of Plates

The use of plates, as proposed by M. Rabut, is claimed to have the following advantages:

- (1) A saving in the labor required to place a given weight of metal in position.
- (2) A greater stability before and during the placing of the concrete.
- (3) Use of the resistance of the internal forces in

the structure in two principal directions instead of only in one as hitherto.

(4) In the case of a plate covered on both sides with concrete, the two faces are independent of the direction of the total tangential force.

(5) In the case of plates covered on only one side, the maximum resistance is obtained by the removal of the neutral axis to a maximum distance, the suppression of the dead zone (i. e., the zone of material between the reinforcement and the surface) which never possesses the same strength as the remainder of the structure, the protection of the concrete from shocks, chemical corrosion and infiltration and the use of the reinforcement as part of the form of shuttering.

(6) The possibility of increasing the adhesion by soldering or welding the bars to the plate in a transverse direction to the tangential forces and to the pressure on the concrete.

(7) The ease with which the use of concrete may be avoided in parts where metal alone will suffice, as in the case of concrete tubes, where the metal acts in accordance with its longitudinal adhesion and transverse tension.

M. Rabut's experience with concrete reinforced with tubes or plates shows:

(a) The forces acting on the tube may be calculated by the ordinary rules.

(b) There is no need to consider the resistance of the filling, as it has, naturally, sufficient resistance to compression. Hence, lean concrete or even sand may be employed.

"Tubed concrete" is specially useful for the economical construction of structures heavily loaded at the end, for the pylons of suspension bridges, aerial hangers or stations, wireless stations or viaducts. This is quite distinct from the use of piles and tubular foundations in which the tube or column carries the load directly.

For structures with simple curves the reinforced bars may usually be replaced by a piece of thin sheet iron which is filled with concrete.

Use in Railway Sleepers

A very important application of this new reinforcement is for railway sleepers, for in all such articles there is an enormous advantage in doing away with the reinforcement of the neutral axis, inasmuch as it also obviates on the dead zone, which may be $\frac{1}{2}$ in. to 2 in. thick, only a total thickness of $2\frac{1}{2}$ -6 in. Reinforced planks made by the new arrangement seldom need any other reinforcement other than a fixed band of metal, which also serves as a mould. The shells of boats can be designed on the new system in an equally simple manner. Curved structures under longitudinal compression, such as dams, reservoirs, or retaining walls, should consist of a concrete wall reinforced by a plate or sheet—which serves as a form and ensures ample resistance to water—provided with reinforcing bars placed in the direction of the flow of the water or pressure. In the opinion of M. Rabut, such a construction will put an end to the disastrous breakdowns which occur at intervals in barrages built on older ideas of reinforcement.

Mr. A. S. Clarson, secretary of the Association of Canadian Construction and Building Industries, has been presented, by the St. George's Society, Montreal, of which he is president, with a suit case fitted with silver mounted accessories. Mr. Clarson will be soon leaving Montreal to take up his residence in Ottawa.

St. Maurice Paper Co. Plans Industrial Housing Scheme

THE subject of workmen's housing is now receiving wide attention both in Europe and on the North American continent. While the question has been somewhat neglected until recently by the province of Quebec in general, several efforts have been made privately by industrial concerns to solve the problem and make the conditions of their workmen an asset to the company. The accompanying illustrations from the work of Mr. J. Cecil McDougall, A.R.I.B.A., architect, Montreal, show what has been done for the St. Maurice Paper Co., Ltd., at Cap de la Madeleine, P. Q.

In this case the object in view was to provide comfortable homes for the employees, built at a cost which would enable their being rented at a figure within the means of the workmen and at the same time give the company some return on their expenditure. This is the basis, or should be, of all "Industrial Housing" and it must not be confused with many suburban developments where the houses, with few exceptions, have been built to sell or rent at figures not governed by the wages of the average workman.

Design Governed by Materials Locally Available

The local labor and materials must always be factors in any industrial housing scheme, and for the one under consideration no brick was available and lumber was plentiful, so that the construction is wood frame, clap board exterior, and plastered on the interior, the foundations being concrete. All the houses have basements, bath rooms, electric light and are heated by a hot water system. There are four standard units being used: Type A with four rooms, type B with five rooms, and type C and D with six rooms.

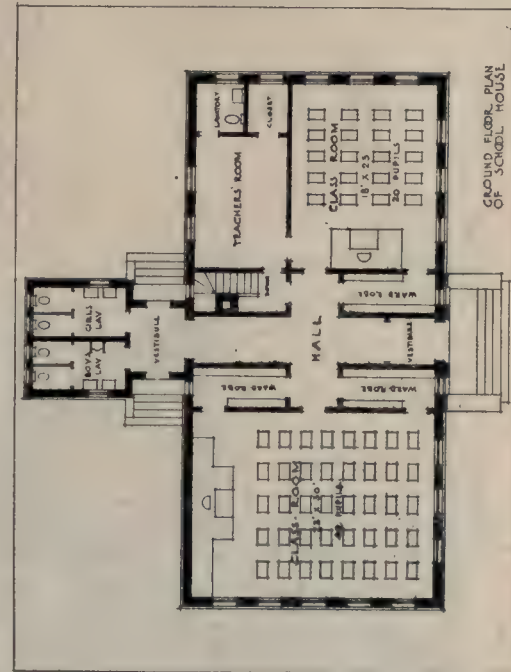
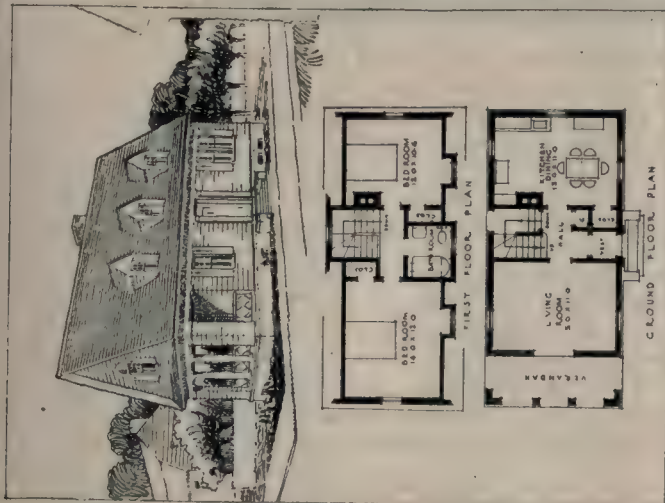
The first two types have a general similarity in the disposition of the rooms, but while the former is designed to be built with the gallery end facing the main road, the other is placed with the entrance facing the road, enabling these two types to be used in combination, forming a group around a court, along the lines of the best developments. In the case of type A, the kitchen and dining room are combined to form a general living room, which leaves the other floor room to be used as a parlor, as is often desired. In type B the dining room and kitchen are separate and the vestibule is eliminated on account of the entrance being protected by a verandah.

The other types, C and D, show two different solutions of the six-roomed house. In type C additional space is obtained in the living room by omitting the hall and placing the stairs next to the entrance. Type D is a little more pretentious than the others, having all the customary requirements within a reasonable area.

The exteriors, always a difficulty in an inexpensive house, have been treated in a simple manner, with due respect for economy and an avoidance of striving after effects.

The school house illustrated is constructed in the same manner as the houses, planned along recognized lines, with all the conveniences required and heated by a hot water furnace in the basement.

Left: Four-roomed house (Type A). Centre: School House. Right: Five-roomed house (Type B).



Left: Six-roomed house (Type C). Centre: Ground floor plan of School House. Right: Six-roomed house (Type D). Plans of workmen's homes developed by the St. Maurice Paper Co. for its employees.—Mr. J. Cecil McDougall, architect.

1150 ton Concrete Steamship Proves Serviceable

THE first reinforced concrete steamship, of over 1,000 tons dead weight capacity, built in the United Kingdom, is shown in one of the accompanying illustration. This vessel has recently gone through her trials in an entirely satisfactory manner and has performed several voyages fully laden with cargo. The launching of this pioneer ship was carried out in June last at Barrow-in-Furness, from the yard of the Ferro-Concrete Ship Construction Co., Ltd.

The vessel is 205 feet long between perpendiculars; 32 feet in breadth, 19 feet, 6 inches in depth and draws 15 feet 9 inches, when carrying a cargo of 1,150 tons dead weight. She is fitted with engines capable of developing 400 indicated horse-power and has a speed of 6¼ knots. The "Armistice," as the vessel is known, made her maiden trip to Ireland, bringing a cargo of grain to London, and the arrival of the first concrete steamship in the Thames naturally at-

crew differs in no essential respect from that to be found in the modern steamship and the equipment is of thoroughly up-to-date character, including wireless telegraphy installation.

It is stated that the "Armistice" has encountered very heavy weather and proved to be entirely seaworthy, one particularly noticeable feature being the complete absence of vibration. With regard to carrying capacity, in consequence of the greater dimensions necessitated by the employment of reinforced concrete, the accommodation for cargo in terms of cubic feet, gives the "Armistice" a considerable advantage in comparison with the steel ship of equal dead weight capacity so far as relatively light cargo is concerned. For example, the vessel brought to London over 900 tons of oats or about 200 tons more than could have been gotten into a steel ship of the same weight carrying capacity. Of course, if the cargo had consisted of iron ore, for instance, the weight carried would have been equal in both cases. As most of the cargo to be dealt with are comparatively light and bulky, concrete ships may be said, in a general way, to possess a distinct advantage in respect of earning power.

This vessel was built on the Hennebique system of reinforced concrete construction, for which F. G. Engholm & Partners have the sole rights in Canada.



The first large reinforced concrete vessel built in the United Kingdom

tracted a good deal of attention from seafaring people and others interested in the shipping industry. The "Armistice" has completed several voyages on the cross-channel service, behaving well in every respect as a sea-going vessel and proving herself to be a remunerative investment to the owners.

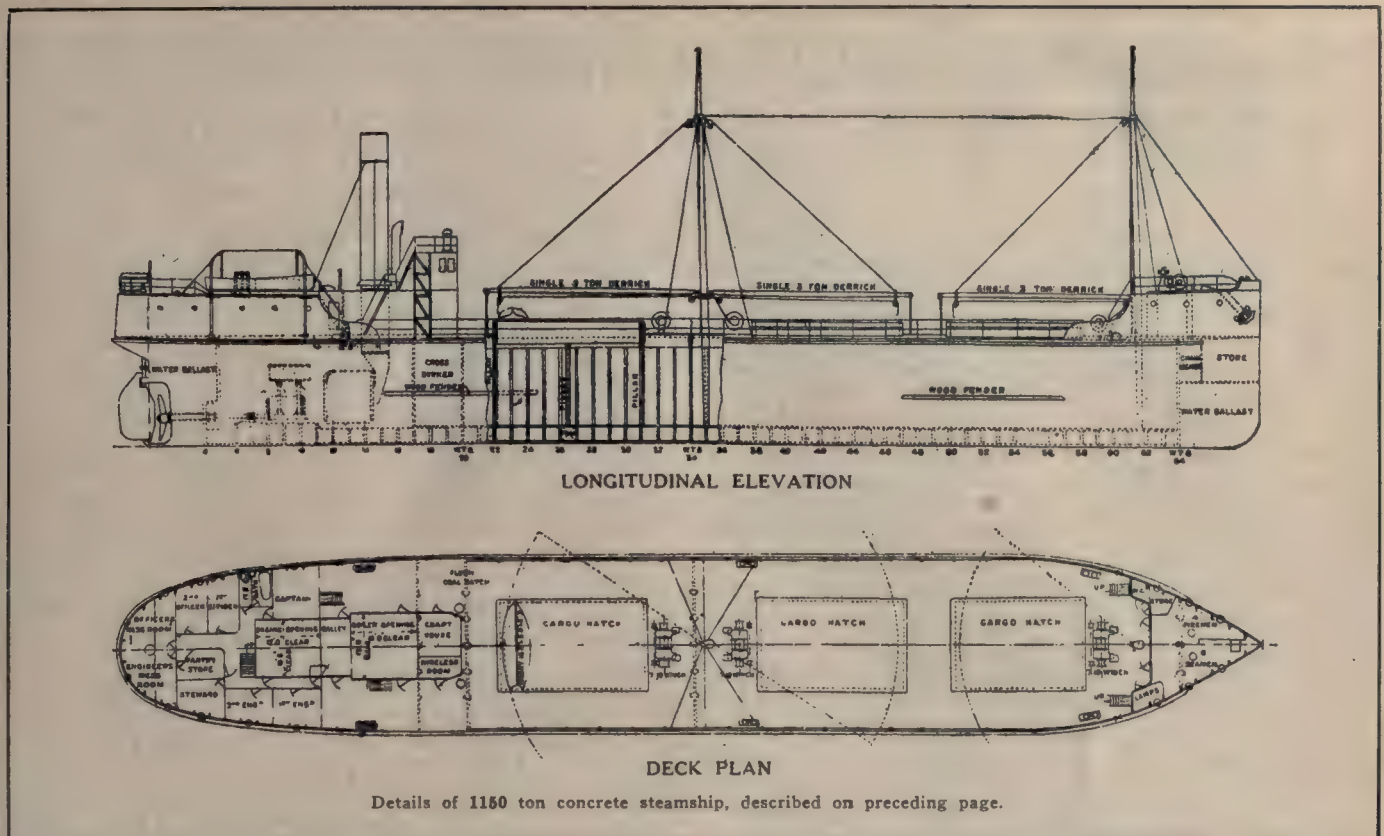
The reinforced concrete caissons, which were employed for the support of the launching ways, were specially designed for the extension of the launching ways into the deep water and, after having been used at any one of the berths in the yard, could be freed and towed to any other berth for launching purposes. The caissons are sunk by the admission of water and floated when necessary after draining off the water at low tide.

The general arrangement of the vessel is illustrated in the elevation and deck plan reproduced herewith. The accommodation for cargo, officers and

Good Roads Association Formed at Sault Ste Marie, Ontario

The Sault Ste. Marie Good Roads Association was organized about three weeks ago and has already over 200 members. Mr. John Ryan, the president of the association, states that they expect to have a membership of 3,000 in the not very distant future and that they have more automobiles in Sault Ste. Marie, in proportion, than any other city in Canada. Mr. W. C. Franz, president of Lake Superior Corporation, is vice president of the new organization, and Mr. L. L. Jacobs is secretary-treasurer.

The Nova Scotia Legislature has passed the Road Machinery and Highways Act which authorizes the raising of loans to be used in road construction and in the purchase of road machinery.



Five Bridges to be Erected in Saskatchewan

The province of Saskatchewan will have five steel bridges erected as soon as tenders can be let and contractors get on the ground. They are as follows: Bridge near Canora, 104 feet, on concrete abutments, across the Assiniboine River, Maple Creek bridge, a 60 foot steel bridge on concrete abutments on the main road from Maple Creek north to Bigstick; the Milestone district bridge, 84 feet, steel on concrete abutments across Moose Jaw Creek west of Rouleau; bridge in Moose Jaw County spanning Moose Jaw Creek near Baildon, which will be a steel structure, 126 feet; Morse bridge across Wiwa Creek, north of Vanguard, 60 feet, steel on concrete abutments.

Two Montreal Contracting Firms Merge

Two of the foremost Montreal contractors, Anglins, Ltd., and the Norcross Bros. Co., have amalgamated under the title of the Anglin, Norcross Co., Ltd. The new firm acquires the Canadian business of Norcross Brothers of Worcester, Mass., with granite cutting and marble works at Iberville, Quebec. Mr. J. P. Anglin will be president of the new company; Mr. Henry J. Gross, formerly of Norcross Brothers, will be vice-president and treasurer, and C. D. Harrington will act as vice-president and manager. The Atlas Bond and Security Company is handling the issue of bonds and preferred stock. The capitalization of preferred stock will be \$1,000,000 and that of common stock \$1,000,000. Both concerns have carried out very large contracts in Montreal and the province of Quebec.

The bondholders of the National Brick Co. of La Prairie have agreed to a scheme under which their rights for interest are modified.

Provincial Highway Ministers Favor Federal Aid

The Ministers of Highways and other representatives of the provincial governments, took the opportunity at the Congress of holding a meeting to discuss the question of federal aid for road work. They were unanimously in favor of the proposal, and it was decided that when they returned to their respective provinces, each should get in touch with and enlist the support of the members of the federal parliament in his province to secure a grant for "Good Roads" from the Dominion Government.

Correction

The Metal Shingle & Siding Company's advertisement in the "Contract Record" of May 21st contained an illustration of the C. P. R. train sheds at Montreal, the largest single skylight job in Canada. The area was given as 25,000 square feet, whereas it should have been 125,000 square feet. The advertisement in corrected form appears in this week's issue.

A proposition for the building of moderate-priced five-room cottages has recently been urged by A. E. Hilder of Winnipeg. He claims that houses of this character can be built with hollow tile for \$2,000. He estimates that a 30-ft lot would not cost more than \$400 or \$500 and the price of \$2,000 for the house is dependent upon: (1) the house would be erected by the manufacturers of the building material, so that there would be contractor intervening; (2) the houses would be built in large numbers together, where 20 to 25 per cent could be saved on the work and inspection and haulage of materials; (3) the houses should be built on land comparatively near the place of manufacture of the hollow tile construction material.

MEMORABLE GOOD ROADS 'CONGRESS AND EXHIBITION IN CANADA'S OLDEST CITY

Under Auspices of Canadian Good Roads Association Attracts Close on 500 Delegates—Eight Provinces Officially Represented

A LARGE number of the delegates to the Sixth Canadian Good Roads Congress, in Quebec City, held May 20-22, arrived on the evening of Monday, May 19, having motored from Montreal to Quebec City in cars placed at their disposal by the members of the Automobile Club of Canada. This trip proved a very pleasant and auspicious preliminary to the Congress—beautiful weather, beautiful scenery and beautiful roads combined to make it a delightful run. The visitors were unanimous in their praise of the highway over which they were driven. This road is for the most part water-bound macadam with a tarvia mat, 16 ft. wide. There is also a stretch of 12 miles of cement concrete and adjacent to the city there is a section of asphaltic concrete. There were nine cars and over forty delegates on the trip.

The convention opened on Tuesday morning, with Mr. S. L. Squire, President of the Canadian Good Roads Association, in the chair.

Through the courtesy of the Quebec Government the delegates had the use of the spacious dining room in the provincial parliament building. Among those present were many distinguished gentlemen. Seated at the head table were the following: Hon. Chas. Fitzpatrick, Lieutenant-Governor, Province of Quebec; Sir Lomer Gouin, Premier of Quebec; Hon. J. A. Tessier, Minister of Roads for Quebec; Mayor Lavigne; Hon. Frank Carrel, M. P., ex-president of the Quebec Automobile Club; Hon. S. J. Latta, Minister of Highways for Saskatchewan; Mr. L. B. Howland, President of the Canadian Automobile Association, and Capt. J. A. Duchastel de Montrouge, Hon. President of the Canadian Good Roads Association; Hon. P. J. Veniot, Minister of Public Works, province of New Brunswick; Premier Arsenault, of Prince Edward Island.

Mr. Squire expressed his great pleasure in welcoming such a representative gathering of men from all over the Dominion. On previous occasions they had had many successful congresses, but this one opened under particularly gratifying circumstances, inasmuch as they had acceptances from representatives of every province in Canada.

Quebec's Interest in Good Roads

The chairman called upon Sir Chas. Fitzpatrick, Lieutenant-Governor of Quebec, to officially open the convention. Sir Charles said it was a pleasure and a privilege to welcome the delegates not only to the city, but also to the Province of Quebec. Particularly was he pleased to bid them welcome in view of the subject which was to be discussed. "In this province, in the past," he said, "we have been anxious for the construction of good roads and I think we may say that our roads are as good, if not better than, those of any other province in the Dominion." He was anxious that they should see the excellent highways they had in the province, but still more, they should see Quebec as it really was and its people as they really lived.

They would then realize, after they had been in touch with the people of Quebec that the broad spirit of Canadianism existed in this province as much as in any other in the Dominion. He recalled that here had come the band of pioneers who had discovered the St. Lawrence, explored the Great Lakes, travelled down the Mississippi, and settled Louisiana. Surely the descendants of these men had the right to call themselves Canadians. And there was no element in the community that had a greater interest in maintaining their connection with the British Empire than had the people of this province, because all that they held dear in language and religion depended upon that connection.

Association Has Power Over the Masses

Sir Lomer Gouin, Premier of Quebec, was next called upon to speak.

"The presence of delegates from nearly all parts of the country is a great compliment," he said, "first to the Canadian Good Roads Association, to the people of the province of Quebec, and to the provincial government. I may say that such a compliment is surely deserved by the Association, which, for the past few years, has spent so much time and so much energy in spreading the gospel of road improvement. Unlike most associations of the kind, it was successful from the very inception. If we go back to the first convention organized by the promoters of the Association, we find that it then met with unquestioned encouragement and that, every year since, its success has been growing. Such a fact shows that the big work it is carrying on has a very strong convincing power, not only over the governments, not only over the road builders, but over the masses. As to the people of the province of Quebec, I wish to say that they also deserve the compliment. I may be charged with flattery, but, even if such an accusation should be threatened on me, I feel that, to be fair, we have to praise the people of the province of Quebec for the very keen understanding they have of the good roads policy. A good roads policy is not a mere matter of course, nor is it, by any means, quite clear to everybody. In fact, when we first put the proposition before the public, we certainly met with an enthusiastic answer in general, but very often, we came across stubborn opposition, and had to face difficulties of all kinds. However, we went to work and devised a comprehensive policy which provided both for local needs and the general requirements of the traffic. The farmer needed a road to bring the milk to the butter or cheese factory, to haul all the farm products to the station; he needed an improved road to connect his farm with his village; the commercial traveller, the doctor, the priest needed the road. To all we said: 'Go on and build your roads, we shall supply money, the engineers and the machinery, whenever necessary.'

Twenty Millions Spent in Quebec Since 1912

"And we find that things came out pretty well, if we remember that up to 1919, 140 macadam outfits are

possessed by different municipalities; that our department of roads has 57 outfits, besides several other pieces of machinery which are at the disposal of the municipalities under easy conditions; that, in 1907, a trunk road was an unknown thing, while, now, we have over 300 miles of trunk roads connecting together the main points of the province; that several other trunk roads to be built by the municipalities are under way, for instance, between Montreal-Sherbrooke, Montreal-Levis, Sherbrooke-Beauceville, Sherbrooke-Beauce Junction, Levis-Fraserville, and that, from 1912, we have spent towards the improvement of our roads about \$20,000,000.

"I do not want you to take this as conceit. I do not look at the things we have done only for the purpose of bragging; far from indulging in self contemplation, I look into the things of the past for the purpose of comparing the work done with the work remaining to be done. I never can forget that, if we have over 2,500 miles of improved roads, our total mileage is 40,000, and that, consequently, we have in store an immense quantity of work and pains. Forty thousand miles is a very long stretch of road. There is a saying, A long lane has no turn. I am afraid that such a stretch as 40,000 miles is long enough to be without any turn, and that none of us will ever see the end of it. However, we look forward with confidence to the final performance of the task, knowing that a very large proportion of the mileage will remain earth roads and will require, for a long time to come, nothing but intelligence and close care.

Roads to Satisfy All Needs

"In this connection, I must say that we have provided in the best way possible for the improvement and maintenance of all kinds of roads with the least cost possible. We have divided the province into 22 sections, each under the direction of an engineer. The engineer has in hand the road proposition in his division and has to handle it along the lines of economy and efficiency. It has been said that the best engineer is he who finds some means of avoiding construction. We expect our engineers to avoid construction, that is to do away with expenditure or to curtail expenditure, whenever possible, without hampering the normal development of road improvement. We want the roads to be up to the needs in every part of the province, nothing more, nothing less. We want the expenditure to cope with every requirement, nothing less, nothing more.

Balance Expenditure and Resources

"This is an important point, the care we have taken and are taking to balance the expenditure with our resources. We make it a point to do all that we can, but nothing that we cannot. Unlimited expenditure does not agree with us. We have an everlasting consideration for the modest little million which is so productive of good, if spent honestly and properly. As a matter of fact, every question we have to deal with is a question of money. Even sentiment sometimes is governed by money. The trouble would be if money was governed by sentiment. At any rate, I am sure you are awake to the fact that the very important questions that will be the matter of your discussion are intimately connected with money, inasmuch as they involve expenditure, and are also intimately connected with sentiment, inasmuch as the carrying out of road works is bound to have influence on the welfare of the whole community.

United Efforts to Produce Success

"The history of road building offers a few facts, which, in my mind, are related together in a similar way to certain facts of our political and social life. Is it not striking to note that Tresaguet, the French engineer, set forth, in 1775, certain principles of road building; which are still of daily application, and that, 25 years later, Telford and MacAdam, both English engineers introduced a method almost identical? Is it not remarkable to note that the stone crusher was invented by Blake, an Englishman, in 1858, and the steam roller by Lemoine, a Frenchman, in 1859?

"I am sure that this alternate action of the French and English genius towards a common object appeals to you as an example of what these two nations have achieved and can achieve for the betterment of the conditions of life. United, they have and they will, in the world, and particularly in our country, journey towards the great and noble ideals that have always been the stake of civilized nations. I am confident that our aims will be attained if we join our efforts together as regards road improvement. We have already taken up our part of the big work and it affords me satisfaction to see the distinguished delegates of the sister provinces today with us, ready to take up the same work and to carry it out in a way that will be of benefit to each of the provinces, and consequently to the whole of Canada. I think I am not mistaken in pointing out that this convention opens under very favorable auspices, since the various racial, political and social elements of the country are co-operating in carrying out one of the most important works the Confederation has ever undertaken. Gentlemen, you have had and you shall have our support financially and morally. We expect you, in your turn, to give the best of your ability and of your knowledge to the solution of the great problems in which we are all interested, and I wish you all the success you are entitled to."

Coming Ahead in New Brunswick

Following Sir Lomer's address, Hon. Mr. Veniot, Minister of Public Works for the Province of New Brunswick, was introduced. The Minister said he had come to listen, rather than to speak. He felt that in coming to the convention he could learn a great deal that would be beneficial in connection with the improvements they were endeavoring to make in his province. He fully agreed with the Premier when he said that "good roads" was one of the main questions in the Dominion of Canada to-day. Up to two or three years ago, however, good roads had been out of the question in New Brunswick, owing to the limited revenue and the small population in proportion to the area involved. Latterly the people had come to believe that better highways were essential, so that they were now actually forcing the hand of the Government in the matter of improvements of their roads. New Brunswick was perhaps alone in the matter of its road policy. While in Quebec, in Ontario and in Nova Scotia the municipalities contributed largely to road work, in his province the government had to bear the expense, except for a very small tax, amounting to about \$80,000 in one year. The question with them was a very difficult one, owing to the limited revenue. Latterly automobile traffic had been becoming so great that the provincial authorities had been able to use the fees to raise quite a large amount of money for highway improvement. In his province they certainly could not lay claim to the construction of "perman-



A group of the delegates to the Congress photographed outside the Provincial Parliament Buildings.

ent" roads, and even if they had the money they thought that owing to climatic and soil conditions, it would not be wise for them to build roads of this class. However, they had started on an improvement programme and hoped they would be able to give the Province "good roads."

The next speaker was Hon. Mr. J. A. Tessier,

After paying his respects to the congress and thanking its organizers for having selected the city of Quebec as the seat of the present convention, Hon. Mr. Tessier dealt with the road situation in Quebec province, pointing out the results that have been accomplished from the efforts which have been made ever since 1907. In speaking of the road building problems now before the country, Mr. Tessier continued: "Of all the great problems of reconstruction, which must engage our attention in this after-war period, that of the improvement of rural highways is perhaps the most important. We are living in a large country where natural resources abound and it is essential that we have numerous and easy methods of communication to make possible the exploitation of these resources and to ensure the speedy distribution of raw materials.

"We must view the good road problem in our country from two different viewpoints; the economic aspect and the philanthropic aspect. From the economic point of view the improvement of roads is primarily important to the industrial and agricultural development of the country.

Wherein Agricultural Districts Benefit

"The advantages which result from the construction of an improved highway in an agricultural district or an industrial centre are incalculable. We already have many proofs of this in the great arteries which we have constructed in the Province of Quebec in the last five or six years. Agriculture has developed to an established degree along the routes of the chief roads; farms have increased in value and the farmers have derived greater profits on account of the ease with which they have been able to dispose of their products.

"In industrial centres good roads are also considered indispensable. In a few months we shall complete the construction of a highway in one of the most important industrial localities of the Province of Quebec, the St. Maurice Valley. The Three Rivers to Grand-Mere route, which is concerned here, has been urged by great industrial companies, located at Shawinigan Falls and Grand-Mere, and I might say that they have even consented to pay a considerable portion of the cost of construction, so much importance do they attach to this project in the development and progress of their enterprises. Let us use, in meeting the difficult conditions of to-day, the same energy and ardor to promote the economic development of our country. The most certain means, I think, of producing this result is to continue to improve our means of rural communication and to construct new main thoroughfares throughout Canada."

P.E.I. Hopes to do Something

The chairman next introduced Hon. A. E. Arsenault, Premier of Prince Edward Island, who, as he told the meeting, was enabled to be present through a fortunate accident. He was no stranger to Quebec, he said, and was quite sure that when the delegates had spent a few days in the ancient city they would look back and repeat the motto of the province, "Je me

Souviens,' ("I remember"). He would not say what they were going to do in Prince Edward Island in the matter of "good roads." They had not reached that point yet, but had been waiting anxiously to hear from Ottawa, and he hoped there would be something forthcoming at the Congress which would enable them to go ahead. "Good roads," he believed, were now just as important to the farmer, as links in the transportation system, as were the railways.

The note of welcome was again struck in an address by Mayor Lavigueur, of Quebec City.

Address by the Mayor and the Citizens of Quebec

"It is a pleasant duty for the Mayor of Quebec to welcome the Canadian Good Roads Association.

"The citizens of Quebec are proud to receive you as representing one of the most useful and progressive organizations of our country, and they are grateful to you for the choice you have made of Quebec to be the seat of your Sixth Congress.

Champlain the Founder of Road Development

"Quebec is so full of historical remembrances that one cannot avoid making reference to past events. Thus it is that Quebec claims the honor of having been the birth place of the pioneer Canadian roads department. Its founder was no less a personage than Champlain himself who traced the primitive pathways around 'l'Habitation de Quebec,' and the next in date was probably the one leading from the river shore to the higher level, where the old Chateau St. Louis was built.

"This is now the moment to welcome the advent of the automobile which has entirely changed the face of things. As one of the most prominent American authorities on road making used to say: 'There are three factors in transportation: Canals, Railways, and Roads.' Canals and railways cannot reach everybody and everywhere, and with the tremendous increase of trade, they are now found to be unable to cope with the requirements of business. The automobile, with its lightning speed, has invaded our roadways and finding them too primitive claimed for speedy improvement according to the modern ideas.

"During the last 15 or 20 years, the powerful influence of automobiles has wrought miracles in the improvement of our ways of transportation, and it is gratifying to find that this sixth Congress of the Association, judging from its rich program, marks a wonderful progress in the most important factor of our national development.

"Bold and Enterprising Policy"

"We are indebted to the present Provincial Administration for the bold and enterprising policy which has endowed our province with a new department in this special branch of public works. A whole modern organization has sprung in a short time and has developed all over the province a system which gave most promising results. These results are publicly admitted and recognized, as was again the case recently before Parliament when the House of Commons discussed the federal law for highway construction. The government then declared that if such an organization as that of the province of Quebec could be obtained, we would have every reason to be satisfied.

"We are indebted to the Honourable Sir Lomer Gouin, the Prime Minister, and to the Honourable Mr. Tessier, Minister of Roads, for the compliments thus

bestowed our province for their wise policy in connection with good roads which is highly appreciated by the people of our province. Public opinion is now better informed and enlightened as to the value of country roads and the whole of our province will soon be enriched by a national system of modern highways.

"For the promotion of such desirable progress, you are here assembled, and I have no doubt that the important deliberations of your Congress will produce beneficial results. It is pleasant to note that in this good work not only the province of Quebec but the sister provinces of Canada and even several of the States of the American Republic are united to discuss all the important questions raised in the program. Your deliberations will be marked by the harmony and good feeling of neighbors who sincerely wish to attain a common desired object. May this Congress mark an eventful day in the patriotic task of securing a friendly 'Entente Cordiale' between us all, which will strengthen the bonds of Canadian national unity."

President Ross, of the Quebec Board of Trade added a further word of welcome.

Even the West is Clamoring for Roads

A breeze from the Prairies was brought to the Congress by Hon. S. J. Latta, Minister of Highways for Saskatchewan. Though, as he said, he came from the back townships to the oldest city in the Dominion, he was already beginning to feel at home, and he believed he was going to learn something at the Congress that would be of assistance in wrestling with the big problems with which they were faced in the Province of Saskatchewan. He pointed out that in the Western country they were merely doing homestead duty yet. In his Province they had a road allowance of over 120,000 miles, and it was estimated that about 20 per cent. of that road allowance could be termed main roads, over which the farmer must carry his product to the elevator point. They had started out in 1905, and had learned to do some things, but "the pride of man keeps lessening as his knowledge grows." In many respects conditions differed out West from the older provinces. Their people came in a very short length of time; vast districts became populated in a few months. These pioneers brought with them their outfits and a great many brought their stock also. They were not settled very long when they found the necessity of fencing their farms, and in a few weeks their homesteads were all fenced in and so were the road allowances. Then began the clamor for "good roads". The speaker said he had come to learn something that would be of benefit in dealing with this problem and expressed his thanks for the hearty welcome accorded.

Principles of Road Building To-day are Not New

Mr. A. W. Campbell, alias "Good Roads" Campbell, the Dominion Highways Commissioner, was next called upon. 'I am sure,' he said, "it must be very gratifying to the officers of this association to find that their efforts are being so successfully attended as to bring together such a large representation from every province in the Dominion. It must be extremely gratifying to you all to find your work is being recognized and endorsed to the extent it has by His Honor, Sir Charles Fitzpatrick, and Premier Gouin. The problem you have to consider is an old, old question, and the principles underlying it are as old as the question itself. These principles are few in

number, but all must be recognized. The rock crusher, first built in 1850, is as necessary to-day as it was in those days, and so with the road roller. The manner of employing these implements is just the same. I have studied the question to some extent from the Atlantic to the Pacific and realize the very great difficulties that have to be faced, and have noticed that these old principles have to be recognized. They may be re-hashed and the story written over again, but still they remain. I am very glad to find such a unanimous representation, so that they may be more fully discussed, and it is to be hoped that the result will be concord and unanimity in the work carried out."

Mr. Campbell also referred to the motor trip from Montreal, and pointed out the great advantages of object lessons of this kind to those interested in road building.

Farmers are Exponents of Good Roads

Hon. Frank Carrel, the next speaker, pointed out that in the neighboring district, when the use of the automobile was first started, the conditions were the same as elsewhere—the farmers were opposed—but to-day the farmers were the greatest exponents of "good roads" and perhaps the largest users of automobiles. The President of the Hamilton Board of Trade had told him that the trip from Montreal to Quebec had been a revelation, for he had never been aware that there was such an excellent road and such fine scenery in the Province of Quebec, and he was going to tell his people about it when he went back, and advise them to see it for themselves. Another gentleman who had attended a great many "good roads" conventions had told him that this one was the largest and most representative he had ever been present at.

Road for the Traffic or Traffic for the Road?

Mr. L. B. Howland, President of the Canadian Automobile Association, brought up an interesting question—are we going to build roads to suit the traffic, or are we going to make traffic suit the roads? "When that is decided," he pointed out, "we can settle on the character of the roads we are going to build, or, on the other hand, if we are going to control the traffic, the sooner a commission is appointed to handle the matter, the better." He remarked that in California, such a commission existed, and if a man wants to establish a truck line, he makes application to this commission for the route, the schedule, and also his rates, and if there is any one else operating on the same route, the man who is on the ground first gets consideration and fairness.

Capt. J. A. Duchastel de Montrouge, who was next called upon to speak, said that it was with great pride that the old guard of the former Dominion Good Roads' Association witnessed the success of the movement and the launching out of a larger and more comprehensive organization. He did not believe there was any bigger or better "good roads" convention held on the continent than that they were now opening. In closing, he expressed his thanks to Sir Lomer Gouin and his colleagues for the very hearty welcome accorded.

Collective Effort Necessary

Mr. S. L. Squire, the President of the Association, also expressed his great appreciation of the warmth of the reception they had been given in Quebec. In regard to the subject which they had come together to discuss, he said there was a key thought—that collective effort was necessary if the highest reforms in

road building were to be accomplished. They had many distinguished citizens from the various parts of Canada, but they would not overlook those from the neighboring country to the south. They had been loyal allies in the time of war, and they would also be look-

Quebec Continues Progressive Road Policy

The Quebec Government has spent approximately \$20,000,000 on road work, and has thus increased the value of farm lands along the roads to a sum far exceeding the amount expended.

It is the aim of the Department of Highways to assist the municipalities as far as possible. Two bills dealing with "Good Roads" were introduced in the Legislature this session. One is to facilitate the lending of money by banks for highway work. It provides that when a municipality has passed the necessary by-law to build a road and to get the money from the Government under the Good



Hon. J. A. Tessier, Minister of Roads,
Province of Quebec

Roads Act, the municipality may borrow from time to time, on notes, on a mere resolution, the money necessary to carry out, under the direction of the Minister of Roads, any of the work, provided that the total amount of the loans it contracts under this section shall not exceed the estimates of the road department. The rate of interest is also limited to 7 per cent.

The other bill is designed to continue the Government policy of seeing that all road work is done under Government supervision. The following clause is added to the municipal code: Any work of construction, improvement, repair or maintenance on roads or bridges may be performed under the direction of a supervisor appointed by the Minister of Roads. Such supervisor appointed by the Minister of Roads shall not be subject to the control or superintendence of the road inspector for the district where the work is being done.

A new plan, in the interests of efficiency and closer supervision, is the division of the province into 22 districts for road work, each district to have its own residing engineer. These 22 engineers are under the immediate jurisdiction of a head engineer.

ed upon as our loyal allies in the time of reconstruction.

It was a significant fact, the speaker pointed out, that they had with them men of so many interests—scientists, captains of industry, speculative road builders and practical road builders, and they were reminded that roads do not recognize any boundaries, provincial, municipal, or national, for the road holds out assistance wherever it goes. Therefore, since the roads of this country spoke a common language, he felt it was very fitting that the Congress should meet in the old City of Quebec. Roads reached the furthest hamlet, passing the door of the richest, as well as the poorest, and work towards the removal of misunderstandings. Ontario, he believed, would know Quebec better as a result of the Congress, and he hoped Quebec would also know Ontario better. "I am convinced," said Mr. Squire, "that this convention will succeed in making history for roads and history for a better understanding that will satisfy the expectations of those who have the interests of Canadian development at heart. Our sons went overseas to place Canada on the scroll of the nations of the world, and we at home should not be less ardent and zealous than they."

In conclusion the President declared the convention officially open.

TUESDAY AFTERNOON

Col. W. D. Sohier—"Federal Aid"

The first item on the programme in the afternoon session was a very interesting address on "Federal Aid," by Col. W. D. Sohier, Chairman of the Massachusetts Highway Commission, which is abstracted on another page.

Col. Sohier's address was followed by an interesting paper by Capt. J. A. Duchastel de Montrouge, C.E., manager of the city of Outremont, on "Highway Maintenance."

The nominating committee was announced by the chairman as being composed of Capt. Duchastel and Messrs. C. R. Wheelock, B. Michaud and T. Regan; the resolutions committee, Hon. Mr. Carrel and Dr. Desaulniers; the legislation committee was composed of the executive.

A paper was presented by Mr. Chas. Talbot, C.E., county road superintendent of Essex, Ont., on "Gravel Roads."

* * *

Annual Dinner and Entertainment

The social features of a convention, such as the Canadian Good Roads Congress, are, perhaps, almost as important as the technical discussions and the business items of the programme, and indicate the tone and spirit of the whole proceedings. So it was that on Tuesday evening, at the annual dinner and entertainment, the successful and enthusiastic atmosphere of the congress was reflected. After a repast worthy of the occasion, President Squire made a brief address, which, he declared, would be the only "shop" to be talked during the evening. He pointed out that the municipal council is the primary school for roads, and considerable money had been lost due to experimenting by the municipalities in road work. There was a federal, provincial and municipal responsibility, and it seemed to him that the experimenting could be handled to the best advantage by the Dominion Government, as the one central organization. He also thought that the time had come when chairs should be established in the universities and more complete



Hon. P. J. Veniot, Minister of Public Works,
Province of New Brunswick

New Brunswick to Concentrate on Gravel Roads

"This year in New Brunswick we are going in principally for improved gravel roads. In the case of a couple of sections where the traffic is more congested, we are putting in stretches of Tarvia, leading from St. John and other important centres. We are also installing a large number of concrete culverts and replacing on our main trunk lines the old wooden bridges with reinforced concrete arch bridges. We expect to spend in the vicinity of from three to five hundred thousand dollars, apart from any Dominion Government grant. During the last two years we spent about one and a half millions on our roads, and of the 1,500 miles of main trunk roads in the Province, about 900 have been improved. We also do a large amount of work on what are known as secondary trunk roads. The roads of New Brunswick are open for automobile traffic earlier this year than in any year during the last fifteen years."



B. M. Hill, Provincial Road Engineer, New Brunswick.

education developed for road building. No one could do this better than the Dominion Government.

After proposing the toast to the King, Mr. Squire asked Mr. Russell T. Kelly, President of the Hamilton Association, to act as toastmaster for the remainder of the evening. The toast list was a long one and the following were the speakers: Hon. W. G. Mitchell and Hon. J. A. Tessier, Quebec; Hon. F. G. Macdormid and Hon. G. S. Henry, of Ontario; Hon. A. Veniot, New Brunswick; Hon. A. E. Arsenault, and Mr. J. A. McNeill, of Prince Edward Island; Hon. Frank Carrel, Quebec; A. P. Sandles, Columbus, Ohio; A. G. Batchelder, of Washington; Col. Sohier, of Boston; T. P. Regan of St. John, and E. G. Breed, New York State Highway Commissioner.

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WEDNESDAY A. M.

Roads as An Aid to Agriculture

The question of "Roads as an Aid to Agriculture," was taken up in a paper by Hon. Geo. S. Henry, Minister of Public Works for the province of Ontario, and also in an address by Hon. J. A. Caron, Minister of Agriculture for the province of Quebec. Hon. Mr. Henry's paper will appear in a subsequent issue.

Hon. Mr. Caron's Address

Hon. Mr. Caron pointed out that the work of improvement in Quebec had begun in 1909, but it was not until 1912 that the policy of the Quebec Government was directed towards the improvement of roads. A new department was then organized and authorized to spend \$250,000 for this work. They were in a different position owing to the fact that they had no experience, no machinery, no engineering organization, and the Department of Agriculture was the only medium for carrying out the work. There was only one French engineer, Mr. Henry, who was competent to undertake the improvements, and it was necessary for him to get together and train a staff. Machinery had to be bought, for which farmers' sons were the only available operators. However, work went on and they spent as best they could the \$250,000 allotted.

"Good Roads" at that time were only spoken of in a few places; prejudices had to be overcome and they had to carry on an educational campaign to convince the farmers that the roads were a good thing for the country as well as for the city folk. They then set out to build roads for the farming community, and by encouraging one parish and getting the improvements brought about in it, they were able to get other parishes to follow, until after two years of that kind of work they found the farmers coming and asking for the improvements. Now the question was not one of educating the farmers, but to choose between different municipalities in the matter of road work.

"Quebec has spent nearly \$20,000,000 on road improvement. In time there will be 40,000 miles of improved roads, 3,000 being already completed. We feel that we can go ahead with the balance, having the people behind us, and that all will be improved in due course."

Good Roads Increase Property Values

The speaker pointed out the improvements to property resulting from the building of roads. He had known instances where farmers who were about to sell their farms changed their minds and decided to keep them when a road was built. For as a re-

sult the value of the property went up. The work on the farm is made easier when there is a good road to the factory, the farm and the village. He had seen the time when the farmer coming to the station with a half load or a quarter load would arrive with a tired horse. After the roads were improved, the horse would come in fresh with three times the load.

"Good Roads" had also been of assistance in war transportation. Materials had been transported which

Prince Edward Island Laying the Foundation of its "Good Roads" System

In regard to the "Good Roads" situation in Prince Edward Island, Mr. McNeill states: "We entered some time ago on a program of building permanent steel and concrete bridges and have spent considerable money along that line, in preparation for permanent work. It is now our intention to have a thorough survey made of all our roads, to classify them and ascertain grades for the purpose of thorough drainage. Our roads will have to be principally of gravel and clay,



Jas. A. McNeill, Commissioner of Roads, Prince Edward Island

thoroughly drained. We have no building materials in the province as far as is known and we are endeavoring to locate gravel either within or outside of its boundaries. If satisfactory freight rates can be arranged, we can obtain it from New Brunswick.

"A branch of the Good Roads Association is in contemplation and we have given an invitation to several of the officials of the association to visit us this summer with the object of having the matter discussed and organizing a branch of the association.

"We intend continuing our policy of building permanent bridges and culverts."

were needed for war purposes much more quickly and economically than if the roads had not been improved. They could now transport the same amount for at least half the cost necessary before the improvement.

Roads had also helped agriculture around towns. Bad road conditions restricted the area cultivated by market gardeners. At the present time farmers living fifteen and twenty miles from Montreal were growing

vegetables for the use of the city, and could bring in their products in one or two hours on motor trucks.

Another advantage of "Good Roads" was the reduction of distances, inasmuch as the time consumed for transportation was much less. The wear and tear was less and the time of the farmer was saved. The importance of good highways for the farmer may be grasped when we consider that in 1918, our agricultural exports in Canada amounted to a value of \$67,173,584.

The value of agricultural products in Quebec had increased very considerably during the last few years.

Saskatchewan Plans a Good Roads System

Asked concerning the road policy in his province, Hon. Mr. Latta said: "Putting it in a sentence or two, we are endeavoring to consolidate some sort of a correlated highway system. Our object is to select from each community to the elevator point on the railway, a main road, and these main roads are to be linked up as interurban roads connecting one village and town with another, while the interurban roads will, in turn, be linked up into trunk roads systems connecting the larger centres. Whatever public monies the govern-



Hon. S. J. Latta, Minister of Highways for Saskatchewan

ment has to spend will be spent having in mind that this system deserves our first consideration, and all the time we are endeavoring to co-operate with the local authorities. At present the chief business of the government will be to concentrate their energies upon the system, of which the foundation is now being laid."

This was not altogether due to the increased price of the products, but also to the augmentation of the crops permitted by the construction of "Good Roads."

Travelling for pleasure, too, had profited by highway improvement. In Quebec they also looked to that part of it. When the farmer has worked six days a week, he has a right to go out and have a little pleasure and for that purpose he wants "Good Roads." Soon all farmers would have automobiles and would be able to visit their friends and go to town with ease and comfort, and farm life would become more attractive, thus stimulating the "back to the land" movement, which was so necessary in order to help pay the cost

of the war and improve the financial condition of this country.

In the province of Quebec they had combined the two propositions—helping the farmer with "Good Roads" and attracting tourist traffic. They now had what was known as the Canadian-American route from the frontier, and in that circuit was to be found one of the best roads of the country. The people of Quebec wanted this tourist traffic. They wanted people from the United States, and from Ontario, and even as far as from British Columbia. They wanted them to come in—and to spend their money. This would also lead to a better understanding, and Quebec would know the other provinces better and the other provinces would know Quebec better.

Paper on "Hot Mix Asphalt Pavements"

A very instructive paper was read by Mr. Francis P. Smith, Ph. B., on, "Hot Mix Asphalt Pavements."

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WEDNESDAY AFTERNOON SESSION

Mr. Alexandre Fraser read a paper entitled "Practical Advice to road superintendents and municipal councils."

In the absence of Mr. A. W. Dean, chief engineer of the Massachusetts Highway Commission, his paper on "Bituminous Macadam" was read by Col. Sohier. Mr. Dean's paper will appear in a subsequent issue.

Address by "Good Roads" Campbell

Mr. Campbell was next called upon to speak. He said he was not in a position to tell very much about federal aid, yet he had consented to say a few words on the topic so ably discussed by Col. Sohier the previous day. The present convention was one of the best road meetings he had ever attended. Very often one could collect together a crowd who were interested in the betterment of our roadways or in the popular cry of "Good Roads," but as to how this object was to be attained they would have very little knowledge. How the work is to be planned, how it is to be financed, the class of road to be constructed and how the work is to be carried out, are questions in which they would have little or no concern, and consequently only an address along the popular line might appeal to them and arouse their enthusiasm. This was the first meeting of the Canadian Good Roads Association he had the pleasure of attending, and it was exceedingly gratifying to know that there were regularly appointed delegates from eight of the nine provinces of the Dominion.

Good Roads and Highway Transportation

The next item on the programme was a paper by Mr. F. W. Fenn on this important subject.

Mr. Paul Sargent, chief engineer of the Maine Highways Commission, who was to have delivered a paper on "The use of refined tar in construction and maintenance," was, unfortunately, unable to be present, but Mr. Sharples of New York, presented a discussion on this question, illustrated with lantern slides.

Annual General Meeting Canadian Good Roads Association

The annual meeting of the association was held on Wednesday night at 8.30.

The minutes were read by the secretary, and passed, and the report of the auditors, which showed a favorable financial condition, was also read and adopted.

Mr. Squires gave the president's report regarding

the work of the directors during 1918. The convention in Quebec city, he said, spoke for itself, as an indication of the progress of the association. There had been a number of amendments in the constitution last year, which placed a certain amount of work upon the executive. One was the securing of directors for the unrepresented provinces. One of the new representatives was the Hon. S. J. Latta. There were two provinces not represented at the annual meeting, but next year they expected to have representatives of every province in the Dominion. This proved that the work of the association was not sectional but Dominion wide. It was largely educational. A great deal of that educational work had been due to the press, and he believed that it might well be enlarged. They found most of the big dailies and weeklies favorable to the movement. Another part of the educational work was in connection with the reports of the convention. Many of those present were not able to follow closely all the papers presented, and their distribution in the minutes no doubt accomplished a great deal of good.

Aim to Bring in all Municipalities Into Association

Regarding membership, it must be Canadian, as the name indicated. The whole progress of the association was in the hands of the active members. Some of the provinces had done particularly well during the past year in regard to membership. Nova Scotia had probably done best in proportion to its size. He thought that the aim of the incoming executive should be to endeavor to get all the municipalities as associate members.

How to finance was one of the problems during the past year. The executive had succeeded in interesting Ontario, Quebec and Nova Scotia, and these provinces had contributed to the association.

On December 9, a meeting had been arranged at Ottawa regarding Federal aid, and had also been attended by representatives of the Municipal Councils, Boards of Trade, and other organizations. When they had left they were satisfied from the statements of the Ministers that there would be no hitch in the granting of Federal aid. He was disappointed that no definite action had since been taken by the Government, but was not hopeless yet that it would not be an accomplished fact this year.

In conclusion Mr. Squires expressed the hope that the members would give the next year's executive as hearty support as they had given to the outgoing one.

Resolutions

A resolution regarding the reduction of freight rates on road building materials was brought up, and carried unanimously. The text of the resolution is as follows:

Whereas during the war the railway companies of Canada have been permitted to increase their rates on stone, sand, gravel and similar road building materials,

And whereas the chief commissioner of the board of railway commissioners for Canada in delivering judgment in January, 1918, in the matter known as the fifteen per cent. rate case, permitted an increase of but five cents per ton on strong sand and similar materials, and stated in his judgment, in his opinion this increase was all that the aforesaid commodities would bear.

And whereas subsequently by order in council the railway companies were permitted to still further increase their rates on stone, sand and gravel by twenty cents per ton, following similar action in the United States.

And whereas Walker D. Hines, director-general of the railroads in the United States, announced on April 11th last, that after consultation with the departments of agriculture, commerce and labor that he had decided to reduce by ten cents per ton the present regularly published tariff rates upon specified road-building materials when for the use in federal states, county, parish, townships or municipal government road work.

And whereas freight rates in Canada on road building materials have always been considerably higher than similar rates in the United States to the detriment and serious hindrance of the Canadian Good Roads movement.

Now, therefore, be it resolved that this annual convention of the Canadian Good Roads Association as-

British Columbia Has Extensive Road Programme

British Columbia has quite an extensive "Good Roads" programme for this season. The ordinary vote for this work is \$1,613,879, and there is also a special construction vote of \$1,500,000. Among the



Dr. J. H. King, British Columbia's Minister of Public Works.
(International Press Photo)

undertakings to be carried out, is the paving of 10 miles of the Pacific Highway on the Lower Mainland, and two and a half miles of Island Highway on Vancouver Island; also the completion of portions of the Trans-provincial Highway.

Hon. Dr. King upholds the policy of appointing district road engineers, claiming that this system increases efficiency and saves money. He points out that in 1910, before the district engineers had been appointed, the upkeep of 7,000 miles of roads and 5,000 miles of trails cost \$1,371,794, while last year the expenditure for 14,000 miles of roads and 8,000 miles of trails was \$1,093,000.

sembled in the city of Quebec, do petition the governor-general in council, the board of railway commissioners for Canada and the railway companies operating in Canada that a decrease of ten cents per ton on road building materials, as aforesaid, be made immediately effective, and that an investigation into rates on road building materials be made immediately by the aforesaid bodies, with the view of still further reducing freight rates on these materials to their pre-war basis.

And that in the opinion of this association such action will prove the needed stimulant to the general development of highway construction throughout

Canada, and will go far to relieve labor unrest and improve the living conditions of the people in general.

Endorse Federal Aid

The following resolution regarding federal aid was also passed:

"Whereas, the Canadian Good Roads' Association has heard with the greatest satisfaction that the Dominion Government is contemplating the introduction of legislation with a view of granting financial aid to the provinces toward road improvements:

"And, whereas, this association considers that such action would be a highly deserved appreciation of the efforts already put forward by the provinces in this connection and a much needed encouragement to their desire to endow the country with a first-class system of good roads;

"Therefore, be it resolved, that the Canadian Good Roads' Association heartily endorses the principle, and strongly urge that it be carried through with the least delay possible."

Another resolution was passed suggesting to the Quebec Government, that the Quebec-Montreal Highway be known as the Gouin Highway, as it was the belief of the members that the naming of main highways would be an incentive to road building.

A resolution was also introduced to petition the Dominion Government to build a proposed harbor commissioners' bridge in order to provide adequate connection between Montreal, the South Shore and the United States. It was urged by the movers that this bridge was of international importance. However, it was considered outside the province of the association to take up the question, and a general resolution was passed instead, urging the Dominion Government to proceed with any projected bridges affecting international or interprovincial traffic.

Two other resolutions, which proposed to request the highway commission of the State of Maine, to complete highways connecting with the Levis-Jackman, and Montreal-Sherbrooke-Levis routes were ruled out of order.

A resolution was passed approving the road building programme of the various provinces.

Winnipeg Favored as Location of Next Year's Congress

Invitations were received from Peterborough, Winnipeg and the provinces of New Brunswick and British Columbia to hold next year's congress in these respective localities. The Hon. Mr. Grierson, Minister of Public Works for the Province of Manitoba, spoke regarding the proposal to visit Winnipeg next year, and hold the congress in that city. Mr. Tollman and Hon. Mr. S. J. Latta also endorsed the invitation, and urged the advantages of making Winnipeg next year's meeting place. Mr. Regan spoke on behalf of New Brunswick, while Hon. Dr. King, Provincial Minister of Public Works, extended a very hearty invitation to hold the congress in Victoria, B.C. It was decided to leave the arrangement of place and date in the hands of the executive, but the delegates expressed, by a show of hands, their preference for Winnipeg.

Election of Officers

The report of the nominating committee, which was carried, recommended the election of the following officers, for next year: Honorary president, A. W. Campbell, Dominion Highways Commissioner; pre-

sident, S. L. Squire (re-elected); first vice-president, A. F. Macallum, Commissioner of Works, Ottawa; second vice-president, Dr. E. M. Desaulniers, M.L.A., Deputy Speaker Provincial Legislature, St. Lambert, P.Q.; secretary-treasurer, Geo. A. McNamee, Montreal; directors, A. L. Caron, Montreal; J. E. Griffith, Deputy Minister of Public Works, Victoria B.C.; S. R. Henderson, president Manitoba Goods Roads Association, Winnipeg, Man.; L. B. Howland, Toronto, Russell T. Kelly, Hamilton, Ont.; Hon. S. J. Latta, Minister of Highways for Saskatchewan; T. P. Regan, St. John, N.B.; C. R. Wheelock, honorary president Ontario Good Roads Association, Orangeville, Ont.; W. G. Yorston, Halifax, N. S.; Nap. Lavoie, Quebec; H. H. Shaw, Chief Engineer of Highways, Prince Edward Island; Capt. J. A. Duchastel de Montrouge, City Manager, Outremont; Hon. Frank Carrel, Quebec; L. C. Charlesworth, Deputy Minister of Public Works, Alberta; W. Findlay, Toronto.

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THURSDAY MORNING

At the Thursday morning session an interesting and valuable paper on "Concrete and Road Construction, Culverts and Bridges" was presented by Mr. Eltinge, G. Breed, chief engineer New York State, Highways Dept., Albany, N.Y.

A paper was next submitted by Mr. A. Paradis, engineer Quebec Highways Department, on "Construction and Maintenance of Macadamized Municipal Roads."

Mr. A. P. Sandles, secretary of the National Crushed Stone Association, Columbus, read a very interesting paper on "Macadam Roads."

Mr. H. S. Carpenter, Deputy Minister of Highways for Saskatchewan, was called upon by the president to make a few remarks. Mr. Carpenter pointed out that their problems in Saskatchewan were fundamentally the same as in the other provinces, but they had to look to the future for hard surface roads. They had 20,000 miles of roads in a sparsely settled country with practically no road material, except a little gravel. They were now making a survey in the province to ascertain the resources of Saskatchewan in gravel.

He declared that though he had found it a long distance to the congress, he had been amply repaid, and he expressed his satisfaction in regard to the list of papers, and his great pleasure in meeting the other "Good Roads" men.

Captain Smith of the Canadian Expeditionary Force, made a few remarks with regard to Mr. Sandle's paper, and the question of macadam roads. He had fourteen months' experience with a motor-driven battery, and it was not possible to express how much they appreciated the roads in France. All the time he had been overseas, he had never seen a gun stuck on the roads, and they had never to resort to horses. During the day there would be no traffic on the roads at all, but at night it was scarcely possible to move along, on account of the congestion. The roads were screened, but the screens were useless if there was dust, and on that account, near the front, much more tar was used. If there was one thing that made it possible to get after the Germans, it was the French roads, as at the end the Germans were retiring all the time over railroads while the Allies were using the highways.

Mr. Campbell's Address

Offers Valuable Ideas and Suggestions on Improvement of Our Highways—Study of Traffic Requirements Needed to Select Class of Road

"You are nearly all technical men," said Mr. Campbell, "who have come here for the purpose of finding out something you do not know now in connection with the road problem, or at least to submit some of your own experience in the past to some well-known authority who has met the same difficulties and has overcome them. The papers read at this convention are of the greatest importance and value. In addition to these experts you have among you representatives of the authorities in each of eight provinces of the Dominion, who have the same idea, very largely, as to the expeditious way in which road construction



Mr. A. W. Campbell, Dominion Highway Commissioner and Honorary President of Canadian Good Roads Association.

will be carried on and as to the provision of the money necessary. Such unanimity must result in very great good. I am exceedingly pleased, viewing the problem from the broad standpoint necessitated by my position, to find further the very great absence of localism or provincialism displayed. It does show the similarity between the difficulties of the problem. This, in the first place, suggests that there are certain principles of road building, common to all provinces, which must be followed in all if success is to be attained. Sometimes we find in meetings in Ontario we consider our problems as being peculiar, and similarity in Quebec. In many instances, too, it may be that New Brunswick considers that they have peculiar conditions that are not comparable to those in other provinces, and each of the others in turn may have difficulties as to the character of traffic, and the requirements of the roads, and as to the classification of the roads which should be built. I find then that in Manitoba, Al-

berta and Saskatchewan, they have the prairie province difficulties to contend with, and in many cases they consider that their section of the country is so entirely different to all others that the treatment of the question must be largely a local one. British Columbia comes in again with its mountains and valleys, and the necessity of chiseling the roads through rock, and there they believe that the locating of the road, and making of the grade is as expensive as laying cement concrete in any other province. Each district has its own peculiarities, but you will find after consideration that the problem boils down to a question of how best to build roads to carry the load."

Mr. Campbell's further remarks are abstracted below.

Ordinary Road Most Important Link in Transportation System

All probably agree that roads are a necessity for the agricultural, the industrial and commercial development of this country. They are necessary in order that our transportation system, which is our most important public work, should be complete. It is composed of three different sections—railways, waterways and highways. These make up the transportation system of this country—all are important, none can be neglected in the interests of a full and complete transportation system for Canada. Our waterways have been approved at an outlay of many millions of dollars and huge sums have likewise been appropriated for our railroads, but I find that most important of all is the ordinary waggon road of the country. Over these must pass in one form or another all the freight that is carried by the railroads and waterways, and if you close up the common roads, the railroads will starve. Then you come to consider a very important question, that is, how to improve the common roads of the country. When I mention this, I have reference to 250,000 miles of waggon roads in Canada, and I am speaking now of Canada as a unit. We have in the neighborhood of 40,000 miles of railroad in comparison with the 250,000 miles of waggon roads. Then how are you going to improve these waggon roads to facilitate the handling of the traffic to reach our market towns, railroads and shipping ports?

It is very interesting to find you discussing the higher class of pavements, and if there was an association formed for the purpose of considering these high class pavements by themselves, it would be a work that would be of great benefit; but the people have got to look after the whole mileage within the province, and how to better these roads and extend them, to my mind, means a broad consideration of the whole question of road improvement, involving, as it necessarily must, the adoption of some high class method. The simple problem of road betterment is an exceedingly important one. How to care for our leading roads is possibly simpler than caring for our ordinary earth roads. In one instance it is a question of finance, and in the other the want of finance. The voluntary aid system has been disappointing, and now has generally been brought to a cash basis, even for the most elementary roads.

Then let us not get carried away by swinging out on a program of exceedingly high class road building. We have reached the conclusion that in the first instance, our roads should be classified according to their importance, and an important work of any department of roads in any of the provinces is in the first

instance to map out the road mileage, and then classify them according to the traffic over them.

Three Classifications of Roads

Roads must be designed to meet the requirements of traffic, and traffic is quite largely measured by population, and the importance of the community in which the road is located, so that when roads have been classified, they will fall into one of three classifications. The first is the leading road through the province, connecting important towns, important markets and passing through densely settled communities. The second class is the roads which act as the principal feeders to the through roads; but simply carry the traffic concentrated by the really local roads. It is pretty well understood that about 10 per cent. of the roads in the province fall within the first class, and if that example is to be taken as correct throughout the Dominion, the roads of this class would cover 25,000 miles, leaving 250,000 miles in the other classes that we considered. In the last few years considerable interest has been taken in the question of classification. Today in every province in the Dominion there are well established departments of roads manned by trained engineers.

It is of first importance that the roads should be carefully and properly located before any expenditure is made upon them. In the next place, it should be seen to that the road is graded according to a well established grade. Whether the road should be 24, 28 or 30 feet should be left to the engineer in charge of the road. The width is gauged by the requirements of traffic, and only after a careful study by the engineer who has gone over the territory, can the question be satisfactorily decided.

Drainage the First Principal of Road Building

I believe we are all agreed that the first principal to be observed is drainage. I think it would be a crime to put one of these hard finished crusts on top of a weak, wet foundation. Very often in our haste, to make a showing on the surface, we take a chance on the foundation, and the drainage of that foundation is not carefully and sufficiently planned. Very often we pay too much attention to the surface, and not enough to the question of drainage. We will discuss how stone should be broken, graded, applied and treated; but we have not spent half the time in connection with drainage. How many of you have seen roads expensively crusted, heaved up by action of frost? Water in the foundation of a road is as disastrous as water in cement-concrete. If the foundation is not properly made, then there is not much use putting on other surface material.

In regard to drainage by ditches on the side of the road, offtake drainage should be provided even if you would have to go to a great distance to get the outlet. There is no use having a ditch if the water lies in it. It will soak in, and when the frost comes it will heave up the road. It is much better to spend the money in the first instance to drain a swamp and the next year to put on the surface. In my twenty years experience I have found that nearly every two or three years a new crop of men comes up, and unless this fact is drummed into them, and they are brought to realize its importance, they will start where you started. It would be a good idea if every road engineer of each province would present a paper on the most difficult piece of road drainage work he has had to handle.

The second principle of drainage is that the road

should be crowned, so as to shed the water. Possibly the perspective shown yesterday does not differ very much from the best practise of to-day. My recollection is that it showed a crown of 18 inches in 15 feet. On an earth road you will possibly find we have decided that the crown of the road should be about 1 inch to the foot. It can be clearly seen that the earth surface requires a greater crown to shed the water than asphalt or cement. On the hard finish, the crown should be lessened in proportion to its ability to shed the water, because that is all the crown is there for. The harder the surface, the more readily will the water be shed. With a very hard surface, perhaps a quarter of an inch to the foot is the best practise.

The third principle is to construct the finishing crust of the road with a material that will be so impervious to water that it will shed it into the ditch, and not absorb it. The earth road will absorb water, and on a gravel road there is some absorption. It is the density of the surface that keeps the water out. Construct the surface of sufficient strength to carry the heaviest traffic that will pass over it.

Consistency with Traffic Requirements the Ideal in Road Making

I am strongly impressed with the importance of grading the road so as to produce the least resistance to traffic. I am also a strong believer in reaching the ideal, by a careful consideration of the principals of road building, and the consideration of the requirements of traffic up to the ideal road. I went over a road with the Deputy Minister of Highways that appeared to be ideal for the class of travel it carried. I have also in mind a piece of cement concrete road between Hamilton and Toronto, carrying vehicles loaded as heavily as fifteen tons. Anything less than the most expensive class of pavement on such a road would be neglect and waste. The point is that the class and cost of the roads should be consistent with the requirements of traffic. A well-crowned, well-dragged, well graded earth road, in a remote part is just as serviceable for the occasional vehicle that passes over it as the \$15,000 a mile road leading into Quebec is for the traffic conditions. The one expenditure is just as consistent as the other. It would be waste and extravagance to put such a road as that cement-concrete road in a remote district, and it is waste and extravagance to use anything between the big central points which will not be sufficient to carry with the least possible resistance the traffic that will pass over it, and maintain that traffic with the least possible expense. Building the maintenance into the construction is often the most economical part of the whole investment. You may build a road costing \$7,000 a mile not sufficient for the requirements, which will incur a maintenance that will be a constant bother and expense, while a road costing \$10,000 a mile would have reduced the upkeep to a minimum.

Striking the Balance Between Construction and Maintenance Costs

I will leave to the engineers the design, but show me what you are planning to handle in the most efficient and economical way the traffic that will pass over your road, and that is the sort of road to which I would say a general contribution should be made. But show me an expensive road which is not required, and I would say "No." It is just about as much a scientific and engineering question to build a first-class gravel road, where gravel is the suitable material, as

it is to build an asphalt or cement concrete pavement. We can find plenty of engineers to design a road, but it is a very difficult problem to design a road that will keep within the limits of construction cost, and not incur a burden of maintenance. These two questions must be considered side by side.

The Standard which would Merit Federal Aid.

Regarding federal aid, as nearly as it is possible, I have attempted to say what standard should be fol-



Mr. G. A. McNamee, secretary-treasurer of Canadian Good Roads Association.

lowed in the work, which would be eligible for aid. I would consider that any road to which aid should be granted should be built right along the line suggested.

Information Forthcoming at Congress Worth Thousands of Dollars

At this congress we have received a lot of information that would cost thousands and thousands of dollars. These men who have spoken to us have got their information through their own experience. It has been very gratifying to me to see the unstinting way in which experts have given out this information.

I have sympathy with the men from the West, where they have to go a long way for drainage, and where the materials are not conveniently located. Perhaps the best assistance in the Prairie Provinces would be to have materials delivered to a convenient point.

New Brunswick Wants Cheaper Freight Rates on Road Materials

Hon. Mr. Veniot, in discussing Mr. Campbell's address, said that his speech had reached the height of his ambition in the matter of gravel roads. In the Provinces of New Brunswick they were not in a position to build macadam, and were forced to resort to the best type of gravel road. Since 1917 they had built 900 miles of gravel roads, and these met the condition of their traffic. They also adopted the system of renewing their wooden bridges along the main roads with bridges of a durable character. In the last two years they had built concrete arch bridges of 15 and 20 foot spans, and in many cases were also designed

bridges of the slab type. One of the most important factors was the transportation of material a long distance for the construction of the roads. In nearly three-quarters of the province they could find an abundance of gravel, but to transport it to sections where there was none, by rail, was almost prohibitive. He had been in touch with the Government at Ottawa, and brought these facts before them, and he urged that the convention should call upon the Government to give them a rate on gravel, which would allow of transporting it at a reasonable cost within a radius of one hundred miles. The rate to-day of 2 3/4c per 100 lbs. would bring the cost to 55 or 60 cents per ton of gravel, which was more than they could afford to pay.

Federal Aid is Topic of Col. Sohier's Address

You in Canada and we in the United States have gone through an era of development of new country that has led from one phase to another. The first



Col. W. D. Sohier, Chairman of the State Highway Commission of Massachusetts

thing that has been necessary to our countries has been to develop large areas and states so that the products of these areas could be sold economically in the markets of the world. This meant, with us, trans-continental railroads and we had a period of railroad and canal building.

Highways Growing More Useful

We have now got beyond the time when you can consider the highways as a local question. We have got where we are travelling and carrying freight long distances over highways, and this was found to be the only solution in the congestion of war times. I submit, that the conditions during the war made no more congestion than the growth of the country is going to make in the near future and more and more are products going to be transferred over highways.

When all is said and done, all the products carried

by rail or water have to be transported to them over the roads.

I would like you to go back a little while in history with me.

It was in the last century that a French engineer announced certain principles of road building. France in 1826 began her system of road building, surveying, planning and mapping a complete highway system for the development of traffic as we have it to-day.

Why did Napoleon start a system of national road building? He started for the defence of the lives and property of the people, and in 1861 there were 371,000 miles of roads, all of it as good as water-bound macadam, and the national highways were 24 ft. wide, of macadam, and graded 66 ft. in width. She laid these roads largely with her soldiers, and they saved her during the present war.

Over 6,000 motor trucks per day passed over the road to Verdun, carrying supplies and ammunition to the defending troops. If these roads had not stood up, the Germans would have broken through, because it was several weeks before they could build even the narrow gauge railway.

England's Practice

England started in the same way as we did here, and we inherited the old antiquated idea of taking care of roads locally. In 1858 she had no road system, or the same road system as you have here. She had about 1,200 turnpike corporations, and practically the only roads were these toll roads; almost all of these failed financially. It became evident that they had to get something more than local borough or parish control, and so England began somewhere around 1875 to adopt a county system of caring for main highways.

There were some 125,000 miles of main roads in England and Wales and about 10 per cent. of this mileage had to be supported by the county.

The local system had fallen through because one person would have a lot of money and another none. The counties today in England are appropriating from \$1,000 to \$1,600 a mile, a year, for main trunk roads, and the Boroughs composing the city of London are spending about \$2,200 a mile a year.

The English Government has also found it necessary to go into road building problem because through traffic demands the through road and many of the counties are unable to stand the expense of a road so largely used by people from other districts. In France they have a system of about 8,500 miles of routes nationales—through lines—all the cost of which is paid by the government and 12,000 miles of Departmental road, for which the government pays part of the cost and the Department the rest. On the other roads, of more local interest, the expense is divided in proportion to the ability to pay. If there are ten miles to be built, connecting the towns, and one township is ten times as rich as the other, that township pays ten times as much towards the cost of building and maintenance. France started with the idea that roads were of national importance and they have saved a great deal more than the price of the roads in the decreased cost of transportation of farm products. Their cost of haulage is 7 cents per ton-mile on the highways. In Massachusetts, we figured on the unimproved road, it is 25 cents per ton-mile. This increased cost of hauling costs the farmer and consumer millions and millions of dollars a year unnecessarily.

England was driven out of the local system. France never had it.

Little Communities Cannot Pay

The question is: are you going to have a certain number of main trunk highways, or aren't you? If you are going to have them, you are going to find that the little community, through which it passes, cannot pay the bill.

We built a road in Massachusetts of which we are very proud, known as the Mohawk Trail. There are 25 miles in that road, the grading alone cost \$20,000 a mile, and when it is completed and surfaced we shall have spent more than the total value of all the property in the three towns through which it passes.

It will require \$600 a mile a year to take care of its maintenance. Can you conceive how those three townships, with a total valuation of \$1,000,000, could pay for this? Each township has about six miles of this road in it and about 80 miles of its own roads.

In the states of Massachusetts, New Jersey and Connecticut we decided, 26 or 27 years ago, that the state had to assist in building the roads if we were going to have any main roads, or good roads through the smaller townships. Financially speaking that means in Massachusetts that about 50 cities and a few townships pay 82 per cent. of all the cost in their state tax and 300 townships pay the balance of 18 per cent.

Fifty dollars per mile per year is the legal tax upon the poorer townships for maintenance of a state highway, but in some of the townships it would take a 5 mill rate to collect that sum of money alone and they have to be exempted from this charge.

Your real question is: are you going to build up your communities? Is it of value to the state and the nation that you should be able to have intercommunication? The roads in France were not the only roads that saved the war. The English Government during the war decided that they would give \$5,000,000 a year aid; that they must help the counties to keep up the roads used by the military, or they couldn't secure necessary supplies in France. The army, navy and forestry paid out over three and a half million dollars a year to keep roads passable, where the municipalities and counties could not have possibly kept them up, and they were essential for war purposes.

Roads Relieve Railroads

In the United States, before the Government began to operate the railroads, we used to think we had a wonderful railway system and yet in 1915 on one of the main roads out of Springfield, I came across 27 three-ton trucks stopped on a bridge, each one loaded with another truck, and was told all of the 54 trucks were going over the roads from Detroit to Boston to be shipped to the French Government.

In 1917 and 1918 a large number of trucks were operated over the roads from Detroit via Springfield, Mass., to Hartford, Conn., and other places to collect aeroplane parts and bring them to Boston for shipment. Many stretches of the highways in New York, Pennsylvania, New Jersey and Maryland were absolutely destroyed because they were not strong enough to stand up under the tremendous number of trucks the government operated over them.

We had a little country road in Massachusetts, 20 years old, built originally with a surface of 6 inch

stone. It probably had a traffic of about 100 vehicles per day ten years ago and 300 per day when the war started.

When the government began to build one of its cantonments, they ran an average of 300 trucks a day over it and later required the same number in erecting a hospital.

After the division sailed for France they only used 100 trucks a day over this road. Now there is not



Mr. S. L. Squire, President of Canadian Good Roads Association

a sign of its oil surface or of macadam on the road, and it has only been maintained by putting gravel on it every few days throughout the winter and we must reconstruct five miles this season.

Is Federal Aid a Good Thing?

We in New England are very much better off than any other part of the United States in the matter of road-building, because of the small area compared to our valuation. In Massachusetts we have 23,000 miles of roads and whatever plan the government may adopt, it is going to mean that Massachusetts will have to do what the cities and towns had to do under provincial aid—pay out more than we are going to get back. About eight states will pay over 60 per cent. of the whole appropriation. Massachusetts will pay 8 per cent. of the revenue of the Federal Government and get back $1\frac{3}{4}$ per cent. of the money that the government spends on highways, and so we are faced with the question of whether Federal aid is a good thing or not.

I myself have changed my mind on the matter on thinking it over.

When it was first suggested, I did not agree, that Federal aid was a wise move for the country, but I have since decided that in no other way can trunk highways be built in the country, and that such highways are essential for its development. In my state we have nearly 200,000 motor cars, the fees on which pay practically all our maintenance on state highways.

These cars run through the State of Maine and Maine has got a good many miles of main trunk highways that cannot be built by the local community because they have not got the money and they don't use

them because the people aren't there to use them, but they are used by the people from other states, and they must secure these main trunk highways. Consequently, I have changed my mind—chiefly because I have been attending road conferences and so have learned what other parts of my country need and must secure to enable the nation to develop its resources.

The United States Government decided three years ago to start Federal aid for highways, and \$75,000,000 was appropriated for this purpose under the Federal Aid Act.

This spring the administration decided that that was not enough and that roads ought to be built faster to help communities recover from the effects of the war and to provide employment.

Government Pays Half the Cost

So they appropriated \$200,000,000, making a total of \$275,000,000 available for the fiscal year of 1920-21. After July, 1920, all that money is available for the use in the states, provided they pay one-half of the cost of constructing each highway themselves. The government also took out the former provision that their contribution of one-half should not exceed \$10,000 a mile. Under the first agreement, I built a road which was costing the state \$25,000 to \$27,000 a mile, and the Federal Government only contributes \$10,000. Today we can build a road costing up to \$40,000 a mile and the government will pay half the cost. The State of Delaware gets \$447,000; Massachusetts, \$4,000,000; Texas, \$16,000,000; Pennsylvania, \$12,000,000; New York, \$13,600,000, and so on.

The government when it gave the Federal aid said that no state could take advantage of it unless it had an organized highway department to draw contracts, plans and specifications and build the roads—and if the United States had accomplished nothing more than that one thing, the formation of these engineering



Mr. A. F. Macallum, first vice-president of Canadian Good Roads Association

departments, they would have gained much more than they spend by the improvement secured by improved highway construction in every state in the Union.

There were twenty odd states that had done nothing, while today every state has had to organize.

(Continued on page 511)

Road Maintenance Principles and Methods

All Highways Require Maintenance—Practical Treatise Dealing with the Upkeep of Earth, Gravel and Macadam Types

By Capt. J. A. Duchastel de Montrouge*

I HAVE no intention of imposing upon this audience a technical paper on the very important subject of Highway Maintenance; I simply want to dwell upon a few aspects of this question from a practical point of view, and bring to your attention a few common mis-conceptions the public seem to have in connection therewith.

At a recent Road Congress I heard an eminent road builder state that the three essentials of a good road were as follows:

- First: Drainage
- Second: Drainage
- Third: Drainage

I agree entirely with him. Thorough drainage is particularly important in a cold climate as ours, where we have so many alternating thaws and frosty weather. If drainage is the most important problem in the construction of the road, maintenance is equally the most

ere" (remain), that is to say "remain for ever." It has been the custom to use this word "permanent" when a more durable type of road construction has been advocated, and many road enthusiasts have mis-used this term.

Another erroneous conception people have about the permanency of a road is due to the fact that they have ideas about the roads built by the Romans and, according to what they have been told, are still in use today. It is quite true that some Roman roads are still in existence and used even today, but the wearing surface has been replaced time and time again.

I know only two permanent features of a road and they are:

- 1—Its location
- 2—The heavy grading work which was done at the early stages of its construction.

All other details of road construction, including bridges and culverts, are more or less of a temporary nature.

A Limited Life

The road surface, or better, the wearing surface of a road has only a limited life, and the sooner the public is accustomed to realize this fact the better it will be. The life of a road surface depends upon the nature of the materials used in its construction and also upon the nature and volume of the traffic traveling over it.

The surface of a roadway should be selected with respect to the traffic the road is liable to have after the improvements have been completed. It is sometimes very hard to determine in advance density of the future traffic. Improved roads will attract an ever increasing traffic, but a fairly close estimation can be arrived at after a little study.

The majority of the roads in this province are of the non-permanent type, and my intention is only to talk upon the maintenance of the earth roads, the gravel roads, and the macadam roads.

There are a few general principles common to all roads that I would like to bring out here.

A bad road wears out much faster than a good road, and consequently the cost of maintenance is greatly increased if the road has been neglected for any length of time.

Two types of wear to roads are known:

1. The Surface Wear.—This wear is caused by the direct contact of the wheels passing over the road, and by the hoofs of horses, and also by the deteriorating action of the elements, such as wind, rain, etc.

2. The Internal Wear.—This wear is caused by too heavy loads and frost action. The materials with which the road is constructed are disturbed from their position and a general disintegration sets in.

Maintenance of Earth Roads

I wish to submit a few suggestions in connection with the maintenance of earth roads. It must be remembered that the great majority of roads in this province are of this type.

- 1.—When the surface of an earth road is very rough



Capt. J. A. Duchastel de Montrouge

important duty which has to be performed once the road has been built.

There are many people who believe that once a road has been built it is down forever, especially if it has been constructed of the so-called "permanent" type, but this is quite incorrect. Road maintenance should begin the day and moment the road has been completed. I do not mean by this that large sums should be spent for maintenance on new roads, but some thorough inspection and superintendence should then be started and kept up.

Permanency Misunderstood

Too many people misunderstand the meaning of the word "permanent" applied to road construction. The dictionary definition of this word is too often taken literally. The word "permanent" is derived from the latin "permanens," from "per" (through) and "man-

*City Manager, Outremont, P.Q.

it is advisable to harrow it with a spike-tooth-harrow, so as to facilitate the dragging. It is preferable that this harrowing be made in the spring when the road surface is still impregnated with water.

2.—All the ruts and depressions of the road surface must be filled with material of same nature of the road surface itself.

3.—It is important that no sod or vegetable matter of any kind be used to fill the ruts or depressions of the road.

4.—In reshaping the road surface use a road drag, and make sure that all the ruts and depressions have been thoroughly filled.

5.—In dragging a road it is important that the dragging be started from the sides of the road working towards the centre.

6.—No ridges should be left on any portion of the road after the dragging has been completed.

7.—The best time of the year to do this work is early in the springtime and, if necessary, after a heavy rain.

8.—It is necessary to remove all foreign substances that might have been brought up to the surface of the road by dragging.

9.—It is also very important that the culverts be thoroughly cleaned, and that their outlets be left in good order. The ditches must be cleaned and enlarged if necessary, so as to improve the drainage.

The cost of maintaining this type of road varies from \$50.00 to \$100.00 per mile per year, according to the width of the road.

Maintenance of Gravel Roads

The suggestions made in connection with the earth roads can be applied to the gravel roads if they have not been superficially treated with bituminous material.

The cost of maintaining this type of road varies from \$15.00 to \$50.00 per mile per year. This price is exclusive of the cost of the cutting of weeds, etc.

Maintenance of Macadam Roads

Mt. Blanchard in his American Highway Engineers' Hand Book treats of the causes of wear in macadam roads, as follows:

"The length of time a broken stone road will last under the traffic depends principally upon the amount and nature of the traffic. If traffic is light, a broken stone surface may last 15 years if originally built of good stone on a good foundation.

"Water, if allowed to stand on a broken stone surface, will soften the latter and cause it to rapidly wear out. When the frost is coming out of the ground in the spring, the surface will also be in a soft condition and require attention. The effect of horse-drawn vehicle traffic is frequently observed in the formation of the horse path, so-called, in the centre of the road. If the surface is given a flat crown, this will be prevented to some extent since the traffic will be encouraged to use the entire width of surface. If the teams track each other the wheels will form ruts, particularly when the road is in a soft condition. The grinding action of the wheels wears the stone and forms dust which, in a dry state, is swept away by the wind, thus leaving the stones in the top course exposed, in which condition they are liable to be displaced by the action of traffic. A heavy traffic of motor-cars travelling at high speed will also cause the broken stone surface to ravel very quickly when the mosaic of the upper course

is exposed. Sometimes when the road is in this condition and the weather has been dry, a concentrated motor traffic of only one or two days' duration will cause ravelling."

Steel Tires and Motor Traffic Detrimental

Modern traffic composed of steel tire vehicular traffic and automobile and heavy truck traffic, has been the cause of many failures of highways that were considered of first class construction up to recent years. The steel tire grinds and pulverizes the road metal, and the automobile traffic sweeps the dust, thus produced, away. To prevent this surface wear it has been necessary to find some material that will set as a sort of preservative to the road surface. After numerous experiments road builders have found that the methods of oiling the roads produced a carpet coat giving good results.

The bituminous carpet is laid on the road with the idea of protecting it from wear from traffic and climatic conditions. It renders the road impervious and lengthens the life of the road considerably.

To be effective, the carpet coat must be laid according to the following rules:

1.—All dust must be thoroughly removed from the road surface with brooms so as to permit an intimate adhesion between the road carpet and the road surface. For economy sake it is advisable that a rotary horse sweeper be used. All the small depressions of the roadway in which dust might lodge should again be swept by hand brooms. The road surface should resemble a mosaic after the sweeping is done, and all stones should be exposed over the entire area.

2.—The liquid bitumen should be applied after heating, and in moderate quantities. The quantity applied per square yard will vary from one-fifth to one-third of an Imperial gallon, all depending upon the conditions of the road surface. All surplus bitumen will be swept with hand brooms over the road so as to avoid the formation of puddles, otherwise the carpet would be of unequal thickness and creeping of the road surface would soon take place.

3.—A couple of hours after the application of the bitumen, the surface should be covered with sufficient coarse sand or screenings to absorb all the bitumen.

Perfect Adhesion to be Aimed at

4.—No road oiling should be undertaken unless the roadway is absolutely dry, otherwise any dampness at the surface of the roadway might prevent the adhesion of the carpet. Unless perfect adhesion is obtained the carpet is apt to break away in slabs during the cold weather.

5.—It is important that the heating of the bitumen shall be constantly observed and the use of thermometers is recommended. Care should be taken that the flash point of the road oil be not exceeded.

6.—In the case of bleeding of finished surface an application of coarse sand or screenings should be made without delay. I have had some experience myself in road oiling and am pleased to state that the results obtained are far beyond my expectations. I find that the roadways that I have treated with road oils have been cheaper to maintain from year to year. They are easier to clean; they are dustless and mudless.

I am submitting herewith a few figures showing the annual cost of repairs to roadways in Outremont for the past nine years, and also the cost of oiling these roadways. It will be noticed that the cost per square yard for the repairs has decreased from 1910 to 1918

at the rate of 50 per cent., and this is in the face of the fact that the wages and material have increased 83 per cent.

City of Outremont Cost of Street Repairs
(Permanent pavements not included)

Year	Total cost	Yardage	Cost per sq. yd.	Average price of labour
1910	\$8,866.81	124,945 sq. yds.	7.1c	\$1.50
1911	10,557.79	157,595	6.7	1.75
1912	14,412.84	208,419	6.9	1.75
1913	11,773.45	244,474	4.8	1.75
1914	15,165.20	273,014	5.6	1.75
1915	18,928.88	300,754	6.2	1.75
1916	11,314.83	302,784	3.7	2.00
1917	12,817.26	322,684	4.0	2.50
1918	11,824.74	355,624	3.3	2.73

Cost of Street Oiling

Year	Total cost	Yardage	Cost per sq. yd.	Average price of labour
1914	\$ 787.45	3,000 abt	2.6c	\$1.75
1915	2,624.80	101,930 sq. yds.	2.6	1.75
1916	5,037.44	187,675	2.7	1.75
1917	6,331.21	184,540	3.4	2.50
1918	6,202.33	138,690	4.5	2.75

In conclusion, permit me to say that we have good maintenance laws in this province. I believe it to be the general wish of road enthusiasts to see the Minister of Roads apply this law with all the rigidity he can.

I was pleased to see recently the appointment of Provincial District Road Engineers; it is a move in the right direction.

Quebec has been in the lead in road building and we are anxious that no other province walk away with the blue ribbon.

Discussion

A question was asked by Mr. Hill, Provincial Road Engineer of New Brunswick, in regard to the repair of bad holes in earth and gravel roads. The ordinary repair man in repairing such a hole would fill it in with rock and cover it with the material of the road. Was not this bad practice, and did it not result in either a lump or a ridge?

Mr. Duchastel agreed that it was and pointed out that roads should not be repaired with material different from that of which they were composed.

The Place and Possibilities of Gravel Roads

By Chas. Talbot, C.E.*

ONTARIO Government reports of 1913 show that the organized portion of Ontario has 56,000 miles of Public Highways. Of this mileage 19,000 miles were gravel roads, 2,700 miles stone roads, 16,000 miles graded earth roads and the balance unimproved. From these figures you see at a glance that gravel was practically the only material used to any considerable extent on highway work and its general use was altogether commendable under the conditions that existed previous to 1913.

Since 1913 traffic conditions have entirely changed, caused by the general adoption of the motor-driven vehicles as a means of transportation, and now it is beyond a doubt that pit run gravel is unsuitable material to use for either the construction or maintenance of the main roads. It is worthy of note that since 1913 the back roads throughout the summer season and the early autumn have been in better condition and more pleasant to drive on than the main highways. With the result that hundreds of miles of serviceable back roads are being destroyed annually by traffic diverted from the main roads because their class of construction is not strong enough to withstand the demands placed upon them. It follows that the whole of our back road mileage, well constructed and serviceable, will be destroyed because of the lack of a comparatively short mileage of first-class roads on our main thoroughfares.

It is these main roads that must be taken over by the Provincial Governments and they together with the roads required to make necessary connections will form the great Provincial Highways of Canada.

Management and Control

The management and control of the Public Highways is one of the greatest problems confronting our Governments to-day and must be solved by them. The undertaking is too complex and altogether too expensive to be successfully directed by the Councils of

the local municipalities. The trunk lines of the roads must be assumed and built by the Provinces.

The necessity of their Provincial control is the outcome of the natural growth and development of the country and its means of transportation. As the distance covered by the users of the highways increases, so the area responsible for the financing of the roads must be extended. But a few years ago the traffic, to a great extent, originated and ended within the limits of the township, and the township could reasonably be charged for it; now the traffic, through the introduction of the motor, has become provincial wide, and the provinces are obliged to assume responsibility for its control. In keeping with these developments the road laws are being altered and the provinces are assuming control of the main roads.

Almost the whole of the road mileage that will be assumed and will form the provincial highways of the Province of Ontario are gravel roads built by the township, the county, or by toll road companies. In a few instances they were constructed by the Provincial Government, and years ago were placed under the management of the municipalities. The highways were well graded, well drained, and the greater mileage well metalled, and were in all respects roads that their builders had reason to be proud of. They have not failed because of inferior construction, but rather because conditions have changed and a class of highway that was perfectly adaptable to conditions existing but a few years ago is altogether inadequate to meet conditions existing to-day.

Gravel Must Always be Used

The failure of gravel roads on main lines of travel does not mean the material of which they were constructed is not a suitable material for road building. On the contrary, a very large percentage (perhaps 90 per cent.) of our total mileage must for generations be constructed and surfaced with gravel or crushed rock, or be maintained as earth roads; more than 50

*Engineer for Middlesex County, Ont.

per cent of the total mileage will be constructed and maintained with gravel surfaces.

[At this point Mr. Talbot read a copy of the specifications of the gravel road construction prepared by the Middlesex County engineer in 1854. These proved very interesting, though he read them, he said, merely to place on record the fact of the long and valued service of gravel roads.—Editor.]

Under the foregoing specifications some 200 miles of gravel road, including the bridges and culverts were constructed within a period of five or six years. Their cost was \$800,000. At the time they were built the total assessed value of the county was less than \$6,000,000.

Since that time the gravel road mileage of the county has been extended to some 1,700 miles, but these 200 miles of wide, well graded, well drained, and heavily metalled roads remain a class by themselves. Their gravel surfaces have been maintained, and some of them will, in the near future, be replaced by a more permanent wearing surface, but the general outline and foundations will remain, and continue to be, a monument to the optimism and foresight of their builders.

You will find the regulations prepared for the guidance of the county councils under the Highway Improvement Act of the Province of Ontario, to a great extent in accordance with the provisions in the specifications above quoted. The grades are built nearly the same width, the hills are reduced to nearly the same grade, the gravel, where gravel is recommended, is placed on the grade practically in the same manner except that the shoulders of the grade are recommended drawn to the sides of the gravel to retain it in position instead of placing it in a trench in the centre of the grade.

Middlesex Specifications

In the Middlesex specifications nearly one-third more gravel was required than is recommended in the Ontario Government regulations, and it had to be screened and the stones broken instead of placing it on the road in its natural condition, and raking out the stones and placing them in the base of the metal bed. The screened gravel produces a road which in the spring and fall and during excessively wet weather, sustains the traffic better than the unscreened material, but the screened gravel road, untreated by bituminous binder, is a rough and objectionable road to drive upon during the greater part of the year. The unscreened gravel road is a little muddy during wet weather and ruts more readily than the screened gravel, but the mud soon dries and the ruts are readily filled with the road drag and the road is a much more pleasant and useful road in that the surface is easily maintained in a smooth and satisfactory condition, provided always the traffic is not excessive.

On ordinary market roads and all other roads of less importance, gravel can be used, and will form a good road surface upon a sub-grade that has been properly prepared and adequately drained. Open side drains as used in the old specifications are unsightly and ineffective. Their construction was justified in 1854, but under present traffic conditions there is no place for them on the highway and no reasonable excuse can be offered to justify their construction or their maintenance. They are jealously protected by the farmers of the adjoining lands, who use them as outlets to their tile drains, but they are of little value to the road for drainage purposes, and should be replaced by adequate under drains, which, when com-

pleted, will render an improved service to both the farmer and the highway.

It is essential that the surface water be cared for at the sides of the grade, but seldom is it necessary to make the open drain so deep that they cannot be crossed without danger of an upset. When it is impossible to avoid the use of a deep open drain they should be properly guarded.

The drainage of the sub soil can be taken care of much more effectively and with less money with under drains than similar results can be obtained with open drains and always you have a safe road that is easily maintained and pleasant to work upon.

With the water line at the road sides lowered 2½ feet to 3 feet below the shoulder of your road grades you still have a road imperfectly drained for on the inclines of the grades and on higher elevations of the road the metal crust of the roads frequently breaks up in the spring time and so accustomed have we become to this condition we have succeeded to a great extent in making ourselves believe it is impossible to prevent their breaking and without hesitation we proceed, as soon as the road surface is sufficiently dry, to level up the broken parts, add sufficient new metal to restore the crown and annually repeat the operation instead of removing the cause of the trouble by placing a few feet of stone and tile drain from the pocket containing the water to the side drain.

In the construction of a new road no surface material should be placed until the new grade is perfectly consolidated and adequately drained and the drainage of the old gravel highways should be perfected if they are to be maintained in good repair at the least possible outlay.

I am of the opinion that it is not advisable to screen or in any way attempt to treat the ordinary pit gravel; neither do I believe it is necessary to use a road roller in the construction or the maintenance of an ordinary gravel road. Harrow, grade and roll with land roller.

Screening Inadvisable

The screened gravel road built with the stone placed in the base and finished with the fine material produces a road, the base of which is very deficient in binding; the round stones push from the wheels and ruts are readily formed, and are quite as difficult to fill as the ruts in the crushed stone road. On this account I have discontinued the screening of gravel. Where a pit contains a large percentage of stone over 2 inches in diameter, a stone crusher, screen and road rollers can be used to good advantage and with this material a waterbound macadam road can be built that will compare favorably with the quarried stone road, and will, if the sub grade has been properly drained, render a good service, but is not better than a road built of a good quality of pit run gravel; and the gravel road always can be maintained at a lower cost than the stone or crushed gravel road.

Throughout this paper I have emphasized the fact that gravel is an unsuitable material to use for the construction of main roads. Living, as I do, in a section of the country where the gravel deposits are plentiful and of a superior quality, and having made a study of the effect of present day traffic upon the gravel road, I have decided it is not advisable to use it on trunk road construction.

Good roads cannot be built on heavily travelled highways without the expenditure of large sums of money. It is a mistake to claim it can be done and any attempt to do so must result in loss and disap-

pointment to those responsible for the work. A large percentage of the less important roads in Canada will be maintained and constructed with gravel surface, and they will in the future, as they have in the past, render good service.

Discussion

The discussion on Mr. Talbot's paper was opened by Mr. B. M. Hill, provincial road engineer, of New Brunswick. In his province, he stated, perhaps 90 per cent. of the roads would have to be built and maintained as gravel roads. Up to two years ago, they had no organization to deal with highways, and had nothing but earth roads, though they had used gravel for maintenance to such an extent that some of them might have been called gravel roads. Two years ago, they determined to build gravel roads, and since that time about 900 miles of road had been built, about 600 miles of it a very good type of gravel road.

It seemed to him that a 30-foot allowance, as suggested by Mr. Talbot, was too wide, as there was a large surface on the shoulder to be maintained. An eighteen foot gravel surface, with well maintained shoulders 3 ft. wide, seemed to him best.

As regards the foundations of gravel roads, he thought that the natural soil was the best foundation provided it could be properly drained.

The big problem they were up against was maintenance. They had built in New Brunswick roads that in 1917 carried 150 to 200 automobiles a day. This traffic had now increased to 600 or 700 cars a day. The motorist would go out and find good roads and would go back and report that the road was in good shape and at once pleasure cars would take that route. Sometimes after a rain storm the motorists who have found the secondary gravel roads very good in dry weather would take them in preference to the stronger built roads, and the result was the gravel road became cut up. His opinion was that they would have to get down to the oiling of gravel roads.

Mr. Hill made further reference to point he had mentioned following Capt. J. A. Duchastel's paper, regarding the repair of holes in earth roads by the ordinary maintenance man with rock filled in with earth. The result, he found, was a lump with two holes on either side.

Logs Used to Carry Roads Across Swamps

In New Brunswick wherever they had to cross long swamps, they had used logs and dumped earth on year after year. Drainage, under the existing conditions, they had found impossible. Sometimes the frost got in and the logs rose up. The gravel would thus get under the logs and they would stay up as a result. They had got the best results by using very heavy spruce boughs, covering them thoroughly with earth and if they were covered in such a way that the earth could not get underneath, they would not rot even though the water got in. Too much earth should not be put on, about 4 or 5 inches.

Mr. Hill asked for the opinions on gravel roads from gentlemen who had experience with them with a traffic of 300 to 700 vehicles.

Mr. Sharples, of New York, said that the problem was much the same as in the northern states. He thought it had been found that gravel roads could stand a certain amount of automobile traffic. Perhaps the limit of 200 a day was about right. Up to that point gravel roads untreated were a good proposition, and it behooved the engineer to study the methods of construction and maintenance. It was important with

these lower types to study drainage. If ever a road was to be given a higher type of surface, there was no better foundations for the "permanent" class than the good gravel road. He believed that even a greater traffic than the 700 cars per day could be taken care of by the gravel road, but there was the dust nuisance to be considered. Then the oil treatment could be used, there being two forms for this purpose, those that form mats and those that penetrate. In this climate the heavier treatments of tar or bitumen were not applicable, as the surface would break easily under frost. In Maine and New Jersey some types of road lent themselves to a surface treatment of cold tar that enters into and forms part of the road. Trunk lines treated in this way a few years ago stood up during the winter season.

Hon. Mr. Latta said that in Saskatchewan many of the communities were very tenacious in sticking to the old path master system of maintenance, and he asked how it had worked out in other provinces.

Mr. Talbot replied that it had worked out badly.

Hon. P. J. Veniot, Minister of Public Works, New Brunswick, said that he was anxious to hear more about gravel roads maintenance. In his province with their revenue and small population, they could not think of beginning to build macadam. If they could improve their system of gravel roads, he thought it was about the best they could do.

Col. Sohier said that in his experience he had never found gravel mix well with mud. He had always kept the mud out of it with brush or stone fill. He had been driven away from log dragging on roads where the traffic exceeded 300 per day, on account of the dust and the rutting of the road, and was forced to resort to some kind of bitumen as the only method of maintenance. Many outlying roads were kept in splendid condition using a 4/5-gallon treatment of cold tar or cold oil in very small quantities. In Vermont and New Hampshire they had maintained gravel roads in very good conditions through constant maintenance and constant dragging, at a cost of \$125 per mile.

Federal Aid is Topic of Col. Sohier's Address

(Continued from Page 506)

This year Texas has appropriated \$60,000,000 to secure an equal amount from the government, and thirty-three states have appropriated a total of \$982,000,000. So you see what a tremendous inducement Federal aid is to the various states to appropriate money to construct highways.

Regarding the situation in Canada, if the Canada Year Book is correct, the Dominion Government is the party that has the money. If the source is correct, the amount raised in the provinces for all purposes in 1917 was \$49,000,000, and the amount raised by the government was \$232,000,000.

In the United States, before the war, the revenue was \$1,000,000,000, and \$100,000,000 is being appropriated for roads, or 10 per cent.

With a growing country like yours it would not seem too much if the Dominion gave 10 per cent. of their revenue to the development of the vast resources in undeveloped territory, destined to feed the world, by paying a part of the cost of constructing the highways necessary for such development. No money, it could spend in any other way, would yield such a prompt and valuable return in increased products, developed farms and decreased cost of transportation.

Design of Steel Structures

Principles Upon Which to Work to Evolve a Structure That is Economical in Amount of Material

THE principal object to be borne in mind by the structural designer—ignoring artistic and utilitarian requirements—is to evolve a structure which necessitates in its construction a minimum amount and cost of materials, the latter being distributed so that the structure will remain stable under the influence of the applied forces. This, no doubt, is a very elementary statement, yet, nevertheless, the saving that could be legitimately made in many designs by a more rigid attention to this fact, if a test be made, would amply repay the designer for his trouble. The economy is particularly marked where superfluous material is accumulated, as in the case of a multiple-storied building or in a bridge. In such a building any undue excess of material in the upper stories has to be supported by the lower stories, and ultimately by the foundations. In the case of a bridge the excess load acts as a force-moment, and where the span is only limited by the capacity of the constructive material this force-moment may have a serious effect in limiting the span. Some features of steel design, and some considerations of economy are dealt with by Albert S. Spencer in a paper read before the Concrete Institute. This paper follows:

The Theory of Structures

The theory of structures embraces the application of mechanical principles to determine the stability and strength of structural units and of the units acting as a complete structure. These principles may be applied mathematically or graphically. The mathematical method is generally the simplest when the structure is rectangular in outline and when the external forces are normal to the exposed surface of the structure, while the graphical method is the simplest for structures having an angular exterior outline or when the external forces are angular to the structure. The principal points to be considered are:

- (1) So to arrange the outlines of the structure as to reduce its resistance to wind pressure to a minimum and at the same time limit the force-moment of the wind.
- (2) The superimposed loads, or applied loads, should be kept down to the minimum consistent with safety.
- (3) To examine the structure as to its stability and to endeavor to eliminate any possibility of distortion or displacement.
- (4) To calculate the magnitude and nature of the stresses in the various units.
- (5) To determine the sizes of the units so that each will safely resist the greatest stress that can possibly be set up.
- (6) Where the force-moments exist, to distribute the materials in any unit so as to create the maximum economic resistance moment, and also by introducing where possible such units as will enable the whole structure to have the maximum resistance moment.
- (7) To take advantage of the variable unit resistance of the constructive materials.
- (8) To select such sections and materials as are readily obtainable and are economical in cost.

(9) To arrange the members and the connections in such a way as to allow the direction and centre of action of the resistance force to coincide with that of the applied force.

External Forces

Economy is obtained in a building by the adoption of a low roof in preference to a high type—that is, by the use of a flat roof instead of a ridge roof, particularly if of large span. The economy is more apparent if it is realized that the extra wind force acting on the ridge roof has not only to be resisted by the framework of the roof itself, but also by the superstructure and the foundations.

A very economical and serviceable type of roof which was recently provisionally patented is a combination of the flat and ridge types, in which the ridged portion or portions are limited to the amount necessary for the natural lighting of the interior of the building. By the adoption of the suspension principle in the arrangement of the framework this special type of roof has many advantages where very large areas are required to be roofed, particularly if the supporting stanchions are to be kept to a minimum in number so as to not interfere unduly with the manufacturing process.

Force-Moments

Reverting to the example comparing a flat type roof with a ridge roof as regards the comparative resistance to wind force, the centre of action of the wind force acting on the flat type roof is much nearer the ground than is that for the ridge roof; consequently, whether or not the ground level is coincident with the fulcrum round which the wind force acts, the moment of the wind force is certain to be reduced thereby, and as a reduction in the external force-moment, leads to a corresponding reduction in the required resistance moment of the building, there is in consequence a saving in the material required to give the necessary stability.

Superimposed Loads

By a too rigid attitude in the use of conventional allowances, or perhaps more particularly as the result of compulsory adherence to by-laws, we are often reluctantly compelled to misuse our constructive materials, and thus violate one of the principles of the theory of structures. Under the present restrictions, however, advantage may be gained by calculating all loads on the lean side rather than on the full side, a procedure always followed by competitive designers who wish to survive as such.

Stability

Although there are many excellent treatises which deal with the theory of structures, too much attention is given to the application of the theory to the stability of structural units without sufficient consideration being given to the stability of the whole structure. A similar deficiency is noticeable in the treatment of this subject at our technical colleges. The result of this is discernible in present-day drawing-office practice, where many designers completely ignore the necessity for such stability calculations.

Determination of Sections

The proportions and properties of the various units must be such that the material is only stressed within safe limits. The proportioning of parts subjected to simple stresses is very elementary and need not be

considered here, but some remarks may be made with regard to where compound stresses exist in a unit, such as occurs, for instance, in struts. Units subject to bending stresses should have a modulus of section as large as possible relative to the area, and the resistance arm should be sufficiently large to reduce deflection to within safe limits. Struts, particularly if of great length relative to width, and consequently subject to flexural stresses in addition to compressive stress, should have the radius of gyration as large as possible relative to the area. Where sudden changes of stress occur the material should not be varied in the same degree, particularly if the material is of a granular nature, and for the same reason; also in cases where the nature of the stress varies intermittently a higher margin of safety should be allowed.

Resistance Moments

Where structural members are subject to flexural stresses economy may be obtained by distributing the material so as to produce the maximum modulus of section or radius of gyration (according to the utility of the member) relative to a given area. This economy is widely recognized; but taking, for example, the list of standard joist sections, it can be easily demonstrated that the compilers have not taken full advantage of this principle of economy in the use of materials. Now the basis of measurement of the comparative efficiency should take into consideration the area—or weight—resistant lever arm or depth, and the modulus section—that is to say, maximum efficiency will be attained when all the resistant factors are a maximum for any given sectional area, after due allowance has been made for limits of production.

A similar criticism may be applied to the inefficiency of our joist sections when used as struts. This has been recognized, probably, by the originator of the broad-flange beam; yet, although the latter type of beam has been in existence for many years, its use has not been encouraged.

It is very desirable that a more efficient range of joist sections should be obtainable, as under the present circumstances we are making a costly misuse of material and seriously jeopardising our position in competing for international trade in structural work.

Unit Stress

The proper use of materials so as to take advantage of the variable utility of constructive materials is generally understood. By way of illustrating this point reference may be made to reinforce concrete construction, in which a compound material composed of concrete (which is strong in compression and weak in tension) to resist the compressive bending stress, while the tensile bending stress is resisted by the steel reinforcement.

Selection of Sections

The total number of sections in any given structure, particularly if speed of manufacture is essential, should be kept to a minimum, and theoretical considerations should be subordinated to practical necessity.

In locating the various members of a structure, or part of a structure, their position should be such that the centre of resistant action should coincide, for economic reasons, with the centre of action of the applied force. This principle is often violated for practical purposes—for instance, to simplify the connection in fixing the position of the members of a roof truss. This departure is permissible, but where the effect

is considerable, as a force-moment of serious magnitude may be created, due allowance should be made for its resistance. The principle is often violated also in the design of connections by locating the rivets or bolts in such a way that the resultant resistance force does not coincide with the applied force, with a similar result to that hitherto referred to.

Principles of Statics

A full consideration of the fundamental principles of statics is beyond the possibilities of this paper, but attention may be directed to those which are most often misapplied.

With regard to the variable distribution of stress, there are two theories regarding the exact nature of the variation, the straight-line theory and the parabolic theory, the former being preferred owing to its simplicity, although the latter is probably more correct. The basis of the straight-line theory is that the cross-section of the beam simultaneously acts round two fulcrum, one of which is in the plane of the outer compressed fibres and the other in the plane of the steel. The basis of the parabolic theory is that the fulcrum in the compressed half is situated at the centre of action of the area of concrete subject to compression, and not at the upper edge. The resistant lever arm is greater for any given section by the parabolic theory than by the straight-line theory, and as the area of the parabola is greater than the area of a triangle with similar base and height, the total resistance of the compressive area is also greater. It will be noted that the error in the straight-line theory is on the side of safety.

Mainly Constructional

East and West—From Coast to Coast

Fire losses in Canada during the month of April amounted to \$850,000.

The work of concreting the Kingston road, Toronto, Ont., is to begin at once.

The township of Rama, Ont., will start repairing their roads on the first of May.

Winnipeg, Man., will spend \$35,000 this year in the repair of plank walks in the city.

Work has been commenced on the race track and exhibition buildings at Woodstock, N. B.

Woodbridge, Ont., will construct two miles of water-bound macadam road at a cost of \$16,000.

Work on the Canada Cement Company's potash plant at Port Colborne, Ont., is progressing satisfactorily.

Three miles of bituminous-bound macadam is to be constructed from Armitage to Holland Landing, Ont.

Plans are in progress for a new plant for the Montreal Portland Cement Company, and tenders will be called for shortly.

Mr. Eustace G. Bird has been engaged by the Hospital Board to prepare plans for the new military hospital at Orillia, Ont.

Orillia, Ont., has let contracts for street paving amounting to \$200,000. Preliminary work has already been com-

menced, but a strike among the laborers has delayed progress.

The Preston, Ont., Lawn Bowling Association is to have a new club house. The contract has been let to contractor James Eagle.

The Board of Control of the city of Toronto, Ont., will meet the government regarding the establishment of a new reception hospital.

Canadian Western Steel Corporation, Limited, with head office at Calgary, Alta., capital \$2,000,000, to manufacture steel goods.

The Ontario Steel Products Co. Ltd. will erect a factory, 80 x 315 ft. in Oshawa, Ont., and will employ 75 to 100 men from the start.

Welland county, Ont., has appropriated \$175,000 for good roads this year; \$100,000 will be used on construction work and \$75,000 for repairs.

The total construction program of civic improvements this year, for the city of Regina, Sask., it is anticipated, will amount to about \$150,000.

The town of Dorion, county of Vaudreuil, P. Q., will shortly call for tenders for road improvements. A bond issue of \$665,000 is now being floated.

According to the statistics of the city engineer, Sault Ste. Marie, Ont., building permits issued for the first six days of May amounted to \$7,650.

The Champion Spark Plug Company, Windsor, Ont., will erect a \$250,000 building in the factory district and will employ one hundred hands at the start.

The town of Williamston, Glengarry County, Ont., will shortly call for tenders for road work, approximating in cost \$100,000. J. Watson is the Town Clerk.

The sampling plant of Campbell and Deyell, Cobalt, Ont., has been taken over by the government and is henceforth to be known as the Timiskaming Laboratories.

It is stated that Blair, Campbell and McLean, of Glasgow, Scotland, are looking for a site in Montreal district to manufacture Chemical plant and machinery.

It has been announced that it is the intention of the Ontario government to take over as a provincial highway the road from Kingston to the Quebec boundary.

The Canadian Pacific R. R. purpose the construction of a new re-inforced concrete bridge at Seigneurs street, Montreal, and also reconstructing the Atwater Ave. bridge.

The three storey addition for the Tetrault Shoe Company on Demontigny street east, Montreal, has now been practically completed. The interior work is well advanced.

The Fort Erie council, Fort Erie, Ont., has passed a resolution offering free water and exemption from taxation for a period of years to all new industries locating in the village.

The school board of Point Grey, P. Q., issued instructions recently to the school architect to call for tenders for the erection of four additional rooms to the Magee high school.

The Local Council of Women, Toronto, Ont., appointed a deputation to wait on the city council regarding the matter of women's representation on the Toronto Housing Commission.

The township of Sandwich, Ont., will construct a concrete pavement on the River Front road from the end of the present pavement at the Lauzon road to the easterly limit of lot 141 in the first concession.

Alexander Craig, Ltd., 11 Juror street, Montreal, P. Q.,

have been awarded the contract for the painting at Union Station, Toronto. The price is around \$120,000 and work will take over a year to complete.

At a recent meeting of the Memorial Committee of the G. W. V. A., St. Mary's, Ont., it was decided to launch a drive to raise \$30,000 to remodel the Opera House as a memorial building for the returned soldiers.

Construction work on the Victoria Road and Richmond streets sewer at Sydney, N. S., has been commenced by Contractor A. E. Cunningham. The sewer will be 5,000 feet in length and of 10 and 12 inch pipe.

The Site Committee of the Masonic Hall Association, Hamilton, Ont., have secured a site for the new memorial hall to be erected for the craft. The site is the Billings property on Jackson street, and is 128 x 290 feet.

The City Works Committee of Winnipeg, Man., intimated at a recent meeting that the Maryland bridge will not be built this year. All preliminary work, however, will be done in order to facilitate an early start next year.

The council of Point Grey, B. C., have agreed to make application to the provincial authorities for \$39,000, their share of the money allotted by the Dominion government for housing purposes, and will begin building soon.

An expenditure of practically \$140,000 in new buildings is to be made this summer at Fort Qu'Appelle, Sask. The recreation pavilion will be commenced at once, while work on the Red Cross pavilion has already commenced.

The Canadian headquarters of the Hoover suction and Sweeper Company, of Dayton, Ohio, is to be located in Hamilton, Ont., and work will commence at once on a three-storey structure at the corner of First and Gage avenues.

The York township council has appointed a housing commission. Reeve Miller, James T. Watson and Corp. Thomas Abraham were appointed for one year and ex-reeve Thomas Griffith and John B. Harris for two years.

A permit was taken out by the authorities of the hospital for Sick Children, Toronto, Ont., for the erection of a three storey addition to the present building. This addition, which will be used as an X-Ray department, will cost \$10,000.

Messrs. Storey & Van Egmond, architects, Regina, Sask., are calling for tenders for the erection of a new Presbyterian church to be built this summer at Kamsack, Sask. The new church will have a seating capacity of 400 and will cost about \$15,000.

A supplementary program of street repairs has been inaugurated by the roads section of the municipal department of public works, Montreal, P. Q. The work which was commenced at the beginning of the month has been practically completed.

Construction work is now under way on the new winter fair building at Regina, Sask. The contractors, Smith Bros. and Wilson, are under penalty to have the building ready for occupancy by July 20th, or one week before the opening date of the fair.

Plans for the erection of a new modern two-storey factory for the National Paper Goods Company, Hamilton, Ont., are being prepared by the architect, F. W. Warren. The site will be next to the site recently secured by the Hoover Suction Sweeper Company.

About twenty-five of the merchants, manufacturers and other citizens of Tweed, Ont., met recently and reorganized the Tweed Board of Trade. The chair was occupied by Mr. F. A. Barlett. Officers were elected, and considerable business was transacted.

The provincial government of Manitoba has authorized

the building of two new roads in the farming districts adjoining the Greater Winnipeg Water District line. These two roads, it is expected, are only the first of many to be built in this district.

Elgin County Ont., report the roads in excellent condition this spring, which is no doubt due to the extensive reconstruction work done last year. The projected work this year is by far the most extensive yet undertaken, involving an estimated expenditure of \$110,000.

Farmers owning 17,000 acres in the Tabor district, Alta., have accepted a proposal from the Canadian Pacific railway irrigation system to extend the Lethbridge system to them by a 20-mile ditch. The total cost will be \$272,000. The construction work will be completed this year.

The superstructure of the new Rushbrooke School, Verdun, P. Q., which is being constructed by Archambault and Leclair for the Protestant Board of School Trustees, is now completed. The interior work is being rushed so that the school will be ready for occupancy in August.

Development on a large scale is anticipated around Winnipeg this summer. Local improvements, bridges, gravelling, sewer and water services and street lights will necessitate the expenditure of approximately \$500,000 in Assiniboia, St. Vital, East and West Kildonan, Rosser and Fort Garry.

The Manitoba Branch of the Engineering Institute of Canada, Winnipeg, Man., has adopted the plan of opening negotiations with the three transcontinental railway companies, with the object of securing the continued operation of the Greater Winnipeg Water District railway on the best possible terms.

American capitalists are at present canvassing the farming district around Three Rivers, P. Q., to ascertain what quantity of beets the farmers are willing to produce, as 60,000 tons of beets will be required annually to keep the three million dollar beet factory, they intend building in Three Rivers, running full time.

The athletic committee of Queen's University, Kingston, propose using the \$5,000 grant of the late George Richardson towards building a first class arena with grand stand, dressing rooms and up-to-date athletic field. The committee have taken the matter up with the executors of the late George Richardson's will.

The Toronto Housing Commission has commenced work on the erection of fourteen houses on Coxwell Avenue. They will be of six rooms and bath, and will represent a medium class, that is, the commission intends building some more expensive and some less. The price at which these will be sold has not been announced.

Tenders were opened recently by the minister of public works for the new isolation wing at the Mental hospital at North Battleford, Sask. The tender for the building was awarded to Wilson and Wilson, Regina, at \$72,800 and to the Regina Plumbing and Heating Company at \$20,473 for the plumbing, heating and electric wiring.

Figures issued from U. S. Government offices at Washington indicate that the building permits in the big republic almost reached the enormous figure of \$2,000,000,000 in the month of March, and passed it by a considerable margin in the month of April. It is believed now that 1919 is to be one of the biggest building years in history.

A party of twenty-four government railway surveyors, in charge of W. R. Maher, engineer, have commenced work on the new T. & N. O. railway extension to Moose Factory, Ont. The geologists and timber cruisers will go north soon to take up their branches of the work.

At the initial meeting of the newly-elected Executive Council of the reorganized Board of Trade, St. Thomas, Ont.,

the following officers were elected: C. Montgomery, president of the old board, was reappointed president; A. A. Ingram, vice-president; W. G. Whiteside, secretary-treasurer and Lorne Lodge, managing secretary.

The members of the Finance Committee of the Municipal Council of St. John, N. B., have agreed that an extension to the General Public Hospital is needed and will make a recommendation to the city council to that effect. The cost is estimated at \$150,000 and the question of the site is to be left in the hands of the hospital commissioners.

The Regina, Sask., contractors have offered the carpenters 75c. an hour for an eight hour day, and contend that this is a fair offer, taking into consideration what has been granted to other trades, who, though they may obtain a higher wage per hour, are unable to obtain employment during the winter months. The carpenters are standing out for 80c. an hour.

The Rathbert Process Steel Company, of Seattle, Wash., has applied to the provincial government, British Columbia, requesting it to guarantee bonds amounting to \$300,000 on condition that the company shall use the money to move its plant from Seattle to Vancouver or its vicinity and shall purchase and erect other furnaces and machinery, which, the company claims, will place it on a profit-earning basis.

A definite announcement can be looked for in the very near future, on the matter of construction of the drydock at Vancouver, according to wire received by the Vancouver Board of Trade from H. H. Stevens, M.P. for Vancouver centre, and S. J. Crowe, Burrard, B. C., to the effect that the harbor board would take the construction of this drydock in hand if private companies could not undertake it.

Announcement has been made of the formation of the Huron Steel Corporation, which will be located at Goderich, Ont., with a capital of \$15,000,000, and will manufacture automobiles, trucks, and parts. The building of a hydro power line to furnish 25,000 h. p. for use at the plant and the enlarging and deepening of the harbor are among the improvements aimed at in connection with the establishment of the industry.

Engineers of the British Columbia government are shortly to visit Chilliwack, B. C. for the purpose of making an estimate of the cost of paving the interprovincial highway through the city. Arrangements are under way whereby the city council will finance 20 per cent. of the total cost, the provincial government 30 per cent and the Dominion government 40 per cent.

The Building Material Dealers' Association of Greater Winnipeg, in a letter written to the Great War Veterans' Association, denies the alleged existence of a "ring" for the monopoly in restraint of trade and invite the Great War Veterans to investigate their books with a view to ascertaining whether at present or at any time since its organization any one of them has made more than a legitimate or living profit out of building materials.

A deputation from the city council of Sydney, N. S., recently waited upon general superintendent Rice, of the Dominion Steel Co., of that city, with the view of obtaining the Steel Company's co-operation in the repair work about to be commenced on several of the city's streets. They received Mr. Rice's assurance that he would help them in this work and promised to repair the street touching the Steel Company's property and commence work on Prince street at once. After this, streets will be repaired in their turn, commencing at the subway on Victoria road.

Over a quarter of a million dollars is to be spent on a tar macadam road from Elk lake to Gowganada, and work on a tar macadam road from Swastika to Kirkland Lake is to be started at once. This, it is estimated, will cost from

\$10,000 to \$12,000 per mile. In the Porcupine district a steel bridge is to be built across the Mattagami River, and the usual road-building programme will be carried out in the clay belt surrounding Cochrane.

The firm of Anglin's Limited, Montreal, P. Q., has completed plans for a larger construction company to be called the Anglin, Norcross Co. The new firm will take over the Canadian business of Norcross Brothers of Worcester, Mass. J. P. Anglin will be president of the new firm, Henry — Gross, formerly of Norcross Bros., will be treasurer and C. D. Harrington will act as vice-president and manager.

Among the few large contracts for building in Montreal, P. Q., is the construction of a suction conduit at the pumping station at Point St. Charles, for the city of Montreal. The work on the conduit which will cost \$55,000 is almost completed. The erection of the examining warehouse on McGill street, by P. Lyall and Sons, and the building of the cold storage plant for the harbor commissioners are other construction projects which will soon be under way.

At a special meeting of the city council of Welland, Ont., the following commission was appointed to administer operations under the provincial government's housing scheme: Mayor Brennan, Chas. Henderson (for two years) and David Dick, Jr., (for one year). These gentlemen have decided to act without salary. The council also accepted the plans of Mr. LaChance for the new fire hall and will advertise for tenders for the erection of this building at once.

The Toronto Housing Commission has been busy inspecting city-owned land and has found several parcels which it will likely take over. The commission's plan is to secure large stretches of vacant land capable of accommodating from ten to twenty houses of the semi-detached type. The greater part of the land under consideration will cost less than \$40 per foot, as a higher price would tend to place the houses beyond the reach of the purchaser of limited means.

Winnipeg citizens have again taken up the question of the "Vimy" Memorial Highway. The construction of this highway has been held up by the war. The highway, it is now proposed, will embrace Edinburgh, Osborne, Colony, Balmoral, Isabel and Salter streets, crossing the Assiniboine river over Osborne street. The City Works Committee has referred the matter to Ald K. A. Heaps, who will report on the project from the standpoint of building a subway at Salter street.

A deputation from the Good Roads Committee of the Board of Trade and the Automobile Association of Peterborough, Ont., waited upon Cavan township council, on behalf of the scheme for having the road from Port Hope to Peterborough, taken over as a provincial highway. The Cavan council unanimously passed a resolution petitioning the Ontario Government to take over the road as a provincial highway. Other township councils will be waited upon and asked to co-operate in this highway scheme.

The projected road to Mont Laurier from Montreal was discussed by a delegation which awaited upon Sir Lomer Godin and the Hon J. E. Tessier, Minister of Roads, recently. This road is to run from Montreal to Ste. Rose (this section being completed), and thence to Ste. Therese, Ste. Agathe, Nominingue, and Mont Laurier, a total of 140 miles laid through the heart of the Laurentian Mountains. The Prime Minister promised that the government would send an engineer to make an inspection, and to report on the conditions and probable cost of the road.

A bulletin, issued by the Bureau of Municipal Research, Toronto, Ont., urges Toronto to "give the Housing Commission right-of-way for fuller speed ahead" so that something may be accomplished to increase the city's housing accommo-

dation during the six months remaining in the present building season. The bulletin emphasizes the need for public co-operations with the Housing Commission to enable it effectively to carry out its work, and also contains an interesting review of the activities of various public bodies along this line during the past twelve months.

The Board of Control of the city of Hamilton, Ont., recommended to the City Council that the sum of \$1,000,000 be borrowed from the Dominion government for the purpose of erecting three hundred workingmen's houses in the city. A Housing Commission was appointed by the controllers, but, in order to avoid any danger of technicalities arising that will involve the city, a resolution was adopted in which it was clearly pointed out that the city will not engage in actual construction of houses, but will just loan money to housing companies or individuals for that purpose.

Of 205,000 tons of steel rails ordered by the Department of Railways last Autumn for the purpose of making necessary replacements and completing certain branch lines of the Canadian National Railway, approximately 155,000 have been delivered and distributed to points at which work is to be done during the present summer. Of the total 80,000 tons was ordered from the Algoma Steel Co. at the "Soo," and all have been delivered and distributed from the Dominion Iron and Steel Company. Some 75,000 tons delivered by that company have been placed along the tracks ready to be put into position.

Many contracts for construction work in the county of Middlesex, Ont., will be let at the June session of the county council. Following is a list of the work: Bridge, East Williams, 50 feet long, to cost between \$2,000 and \$3,000; two reinforced concrete bridges on Longwood road, to cost \$2,700; bridge on Hamilton road, near Nilestone, to cost \$800; 50-foot span and 24-foot span in the township of London, to cost \$5,000; 75-foot span in township of Strathroy, over Bear Creek, with 18-foot road and 5-foot sidewalk, to cost \$5,500; reinforced concrete culvert, Westminster Township, \$600; reinforced concrete culvert on the commissioners' road at Springbank, to cost \$500; sidewalk on Byron bridge, \$3,000.

Hon. P. J. Veniot, Minister of Public Works, Fredericton, N. B., recently returned from Ottawa, where he spent some days interviewing Hon. Dr. Reid, Minister of Railways, and Commissioner Campbell, in respect to federal aid for the construction of permanent highways in New Brunswick, and he reports that the classification of permanent roads, as adopted for this province, had been approved and plans and other data had been submitted at Ottawa together with a report as to how the roads already built in this province had come through the past winter. Despite the fact that the resolution which precedes the legislation in parliament, had not been passed by the House of Commons, permanent road work will be gone ahead with in New Brunswick this season.

Personal

Mr. A. S. Mathers, B. A. Sc., has withdrawn from the architectural firm of Banigan, Mathers & Thompson, 17 King st. east, Toronto, Ont., and the business is now carried on under the name of Banigan and Thompson.

Lt.-Col. W. N. Moorhouse, D.S.O., has just returned to Canada after four years on active service. At the cessation of hostilities he was in command of the 3rd Battalion, Canadian Machine Gun Corps. His partner, Capt. Allan George, also served for two years overseas with the 10th Battalion Canadian Railway Troops. They are now resuming their practice as architects. The firm will be as formerly, George & Moorhouse, 65 Victoria Street, Toronto, Ont.

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The "Good Roads" Ideal

THE reasons why we should have "Good Roads" in Canada have been enumerated again and again—for the development of commerce and agriculture, the supplementing of the railways, the growth of the community spirit, the reduction of the cost of living, the revival of the "back to the land" movement. But perhaps the highest object which "Good Roads" can assist in achieving is the bringing about of national spirit and national unity in this Dominion of ours. Lack of roads isolates the city from the country and the town from its nearest neighbors. Railways bring the ends of the country together, but bad roads keep neighboring communities apart. Roads are the last and the most important link in our transportation system. Without them, there is bound to be a tendency towards parochialism and narrowness. The country folk will not know the town folk, and the town folk will misunderstand the country folk. Some of our cities are like islands in a desert.

This isolation also has a deleterious effect upon the physical well-being of our people. Man was created a fresh air animal, and parks are, after all, only a substitute for the great out-of-doors. We want roads to bring to the dwellers of the dusty and smoky cities a breath of the pure ozone of the country and a glimpse of the blue sky and green fields, and to bring the farm-

er within reach of the advantages and comforts of the city. If we reached this ideal, perhaps it would help to solve some of the big problems before us, which have as their root a sense of unrest and dissatisfaction among our people.

The Sixth Canadian Good Roads' Congress, held at Quebec City two weeks ago at which there were delegates representing eight of the nine provinces, and which was marked with enthusiasm and unanimity from start to finish, is definite and absolute proof of the feeling of the Canadian people towards "Good Roads." The executive of the Canadian Good Roads' Association certainly deserves the thanks and congratulations of those who have this Dominion's interests at heart, for the work they have done and the success they have achieved. We take the Congress as an indication of the real spirit of Canada at the present time and a hopeful augury of the progressive and united action which will bring this country to the place she deserves among the nations of the world.

But there is still one missing link in the chain of co-operation. Now that the trumpet has been sounded and the "Good Roads" battle-cry is ringing in their ears, it is to be hoped that the Dominion Government will no longer hesitate to take a definite part in the forward movement, knowing that they have the support and approval of the people of Canada.

Clay in Relation to Pile Driving

A S a result of ninety-five experiments made with clay, some taking forty hours each, Mr. A. S. E. Ackermann derived the conclusions printed below regarding clay in its relation to piles. The experiments were conducted between December, 1917, and February, 1919, and the main series of tests were carried out by forcing into the clay various bodies representing tapered and parallel piles, some with blunt and others with pointed ends. The original object was to determine the relationship between the horizontal pressure and the depth at any given point in clay.

By having only one guide hole for the guide and load rod in the apparatus used, there was no danger of cross-binding. The load was applied to the top of the rod by placing weights in the self-centering carrier, which ensured the load acting centrally and vertically down the rod, for the self-centering carrier and the rounded top of the rod constituted a rude form of ball-and-socket joint. Care was taken to keep the guide rod vertical throughout each experiment. This needed a little more care than that necessary to start with it vertical.

Measurement of Penetration

The penetration, *h*, was obtained from two measurements on two opposite sides of the pile or other body which was being gradually forced into the clay (for in all the experiments the loads were applied gradually. No impactive forces were used such as are used in pile-driving.) Each of these two measurements was made by callipers vertically between a horizontal projection from the top of the pyramid (or from a bracket on the guide-rod) and a small plank of wood which, before the start, was pressed into the clay until the top surface of the wood was level with the surface of the clay. The mean of these two readings was deducted from the initial reading, when there was no penetration, the difference being the penetration, *h*.

It was found in the case of the pyramids that they

soon came to rest, especially with the larger percentages of water, but in the case of the bodies with parallel, or nearly parallel, sides there was a tendency for the penetration to increase very slowly for a considerable time, but ultimately these bodies too came to rest. In consequence of this creeping, each load in most of the experiments was left on for the same time, so that the readings of, h , might be comparable, even though a somewhat greater value of h would probably have been obtained if the loads had been left on longer.

In the earlier experiments it was not realized how extremely important is the effect on the results of the percentage of water in the clay, and this percentage was consequently determined in only a few of the earlier experiments. One of the most important facts brought out by the experiments is this effect of the water in the clay, and when once this had been appreciated the percentage was always determined for each set of experiments.

Conclusions

The following main conclusions were inferred from the experiment:

1. For tapered bodies gradually forced into clay the load necessary to produce a given penetration is proportional to the area of the surface of contact between the clay and the body.
2. The load to produce a given penetration is very much greater the less the percentage of water in the clay.
3. Clay containing a definite percentage of water, and at a definite temperature, has a definite pressure of fluidity, and when this pressure is reached and maintained the clay yields indefinitely as a dense viscous fluid, unless it be restrained from flowing or caused to rise so as to produce a statical head of clay.
4. The pressure of fluidity is greater when the percentage of water is less, or when the temperature is lower.
5. The pressure of fluidity per se is independent of the depth and depends solely on the percentage of water in the clay and the temperature of the clay.
6. For equal depths, tapered piles support a larger load per unit volume of the piles than piles having parallel sides.
7. The reason for (6) is that in the case of tapered piles their surfaces keep in more intimate contact with the clay, with the result that the support due to the friction on their sides is greater than is the case in parallel piles.
8. With a view to increasing the resistance of piles they should be corrugated as well as tapered.
9. The reasons why parallel piles with blunt ends are not so efficient per unit volume are that the pile entering the clay rubs the surfaces near the top of the hole so much that the friction (or cohesion) is reduced there, and also because the clay in squeezing laterally from the end partially loses contact with the sides of the pile, thus also reducing the friction on which the supporting capacity of a pile depends.
10. The mean intensity of friction for the same depth of penetration on the sides of parallel piles is greater in the case of piles of small cross section than in the case of larger ones; but if the diameter of the pile be reduced beyond a certain amount (the depth of penetration being constant) then the mean intensity of the friction appears to decrease again. Consequently for a given quantity of material of which to

make piles a large number of small piles is more efficient than a smaller number of large ones.

Pointed Piles More Efficient

11. Pointed piles are more efficient per unit volumes of pile than blunt ones because the points cause a more gradual lateral displacement of the clay, thus leaving it in more intimate contact with the sides of the pile.

12. The action of the point of a pile is to cause the pressure of fluidity to be attained on its surface, whereupon the clay flows out of the way.

13. The resistance to penetration is considerably greater the lower the temperature of the clay, probably because the pressure of the fluidity increases as the temperature decreases.

The density of clay decreases as the percentage of water increases.

15. The work done per unit volume of displacement increases as the angle of taper decreases; but when the taper approaches 0, or is 0, then the work done is less than when the angle of taper is larger, for the reasons given in (9).

16. When forcing a disc into clay, the sides of the hole do not crush in (unless a certain critical depth be attained) because the pressure of fluidity of the clay having been attained immediately under the disc, the clay flows laterally; but the moment it has escaped from beneath the disc the pressure is reduced to the statical pressure corresponding to the local head of clay, and when this is less than the pressure of fluidity the clay does not flow into the hole made by the disc, but, if the penetration of the disc be carried far enough, then ultimately the statical head of clay will be equal to the pressure of fluidity and the sides of the hole near the bottom will crush in.

17. The friction of clay on wood is greater than on tin plate.

Brig.-Gen. C. H. Mitchell to be Feted by E. I. C.

The Montreal branch of the Engineering Institute of Canada will tender a banquet to Brigadier-General Charles Hamilton Mitchell, one of the most distinguished members of the Institute, who is returning to Canada to re-enter civil life after nearly five years of outstanding service with the Allies. The exact date of the banquet will depend on General Mitchell's arrival in Montreal. The gathering is planned to be entirely an engineering one and arrangements are being made for some eminent speakers to take part. General Mitchell has accepted the office of Dean of the Faculty of Applied Science and Engineering of the University of Toronto.

Mr. H. A. Wickett has severed his connection with the firm of Jas. A. Wickett, Limited, and has established a business for himself as general contractor, with yard and office at Front and George streets. Mr. Wickett is in a position to handle masonry, excavating, plastering, carpentering, and concrete work, and will also make a specialty of repair work.

The contract for the construction of the new educational block for the Royal Military College at Kingston has been awarded to the Pigott-Healey Construction Co., of Hamilton, Ont., at \$324,884. Ten tenders were received, ranging from \$326,884 to \$426,895.

Clay Products Men in Convention See Brighter Prospects for Construction Industry

Seventeenth Annual Meeting of Canadian National Clay Products Association Reflects Greater Stability Among Brick and Tile Plants

THE seventeenth convention of the Canadian National Clay Products Association was held in the rooms of the Association of Montreal Building and Construction Industries, on May 26-28. Mr. Thomas Kennedy, of Swansea, Ont., presided. In the absence of the mayor, Mr. N. T. Gagnon officially welcomed the members. Messrs. R. H. New, Hamilton; Geo. H. Clippert, Detroit; T. A. Randall, secretary of the National Brick Manufacturers' Association, Indianapolis; Will P. Blair, vice-president of the National Paving Brick Association, Cleveland; and Col. W. C. Trotter, St. Johns, P. Q., replied to the welcome.

Business Will Increase When Public Realizes that Prices Will Not Come Down

Mr. Clippert hoped to see many American brick manufacturers members of the Canadian Association. There was no reason in his opinion why they should not be, as they were one now. The situation in Detroit was outlined to indicate the misapprehensions of the public regarding prices. The Detroit brick manufacturers were very busy. When the armistice was declared they knew that the Detroit architects had a great deal of work in hand, but very little came out. A committee of brickmakers was appointed to wait on the architects, who told the deputation that the architects' clients were waiting for prices to come down. The deputation knew that prices would not come down, and so a meeting of architects, real estate men, lumber dealers and others interested in the building trade was called. Publicity was given to this conference, with the result that the public were satisfied that there was no prospect of lower prices. After that business increased with a rush, and the difficulty now was to manufacture brick fast enough.

Mr. T. A. Randall expressed the opinion that business would gradually improve, both in the United States and Canada. Conditions were similar on both sides of the imaginary line that divided the countries. He believed that in Canada the brickmakers had been able to obtain better prices than in the States. There was no use in selling bricks too cheap. People bought bricks because they wanted them, not because they were cheap. He was glad to know that the associations were working together.

Col. W. C. Trotter referred to the unsettled labor conditions in Montreal, and remarked that with the thousands of returned men and with the large number of men out of positions it was strange to find men giving up their jobs.

Co-operation Will Benefit Industry

Mr. Higgins, of Manchester, England, stated that he was on a visit to Canada and the United States with a view to inspecting plants and securing pointers on the manufacture of brick and tile. The difficulties in Canada in the matter of labor, etc., were the same as in England. Mr. Higgins, touching on the question of price, told of the experience of the brick makers of

Manchester, where an association had been successfully carried on for several years. Its formation had been the means of bringing the manufacturers together, and of removing jealousy. Prior to the formation of the association there had been price cutting, so that common brick sold for \$3.50 per 1,000; just before the war it had risen to \$6. The association had saved many Manchester brickmakers from disaster. The moral was that it was only by co-operation that manufacturers could benefit the industry.

After a few words from Mr. Haigh, Mr. W. P. Blair said that in the States the manufacturers had been too slow in reaching out their hands to one another.

Clay Industries Hard Hit by War

In the course of his presidential address, Mr. Kennedy said that the convention marked two innovations, viz., the holding of the meeting outside of Ontario, and the holding of the meeting at this time of the year. They met this year under much happier conditions than those at the last meeting. They did not believe that any class of business was harder hit by the war than the clay industries. Their business being largely with the building trade and with the municipalities, the fact that the builders were unable to secure either bank advances or mortgage loans, and that the municipalities closed down on all work that could possibly be postponed, brought the clay working industries almost to a standstill at a very early period of the war, and what little business there was could only be handled under the greatest difficulty, owing to the fuel and labor shortages. Meanwhile the usual overhead expenses had to be carried. The fact that quite a number were compelled to go out of business, therefore, was not to be wondered at. Today there was a very general feeling that the country was entering upon a period of great prosperity; that once the peace treaty was concluded and the labor question settled, Canada and the United States would both go forward with a bound; that the demand for equipment, material and manufactured goods would exceed anything that had heretofore been known; and that there would be a very large amount of federal, provincial, municipal and other large works, all of which would create a great demand for clay products.

The president pointed out that the fuel situation had greatly improved, but declared that the labor conditions were a cause of much anxiety. They were, however, hopeful of a settlement on a basis that would be fair to all parties concerned, which was sufficient reason for being optimistic.

The Patriotic Service of the Clay-Workers

In remarking upon the fact that the clay-workers had borne a noble part in the war, thousands having enlisted, the president mentioned that amongst men who are better known were Col. Wilson, manager of the Sun Brick Co., Toronto; Major Peter Anderson, brick manager, Edmonton, who escaped from Germany; Col. Herbert Trotter and Major Clifford Trot-

ter, sons of Col. W. C. Trotter, president of the Standard Clay Products, Ltd.; Lieut. F. B. McFarren, manager of the Interprovincial Brick Co.; Lieut. Green, of the Sun Brick Co.; Lieut. Chambers, of the Ontario Provincial Clay Products Works; Lieut. Price, of Prices, Limited; Wm. Burgess, Jr., of the Don Valley Brick Works; Wm. Pears, Jr., of West Toronto, who was killed in action; Lieut. D. S. Graham, son of the president of Shales Products Ltd.; Lieut. F. McCannell and Wilson McBain, of the Milton Pressed Brick Co.; Thos. Kennedy, Jr., son of the president; D. D. Ommudson, superintendent of the Citadel Brick & Paving Block Co., who served in the U. S. Army. These were only a few of the many hundred names that might be given. Ninety enlisted from the Don Valley Brick Works alone, sixteen of whom were killed in action.

Should Expect a Reasonable Profit

A great deal had been said as to the inability of the returned men to settle down, but on comparing experience with a number of the manufacturers the report was that while returned men taken at work new to them might not have taken hold, the old employees returning to their positions had almost invariably settled down at once.

Regulation of prices was not any part of the work of the association, but nevertheless each member should determine for himself that he would not part with his goods without a reasonable profit on the transactions. It was absolutely useless to give time, employ their capital, use their clay, wear out machinery, and have all the worries and anxieties of business unless they were making a profit on sales. They must not be afraid to ask a price for their products.

The president, in concluding, pointed out the advantages of the conventions, in exchanging ideas and in forming friendships with those who were in the same line of business.

Tile Drainage Situation

Following the report of the executive committee and of Mr. Gordon C. Keith, secretary-treasurer, the report of the Tile Committee was presented. The committee was composed of members appointed by the association and the Western Ontario Clay Workers' Association, and its object was to endeavor to find solutions to the various problems confronting the Ontario tile makers in their efforts to supply the demand for their product and also to work out a plan to expedite the work of under-drainage of all lands within the province that could be benefited thereby. The committee, among other things, agreed that it was necessary to secure inspection and standardization of drain tile; tile manufacturers should be licensed; ditching machine operators should be licensed; the government should, if necessary, assist the drain tile industry, financially; the Tile Drainage Act should be amended to permit a farmer to borrow a certain percentage of the cost of the work done and not a maximum amount as at present, whether he owns 25 or 200 acres; and the government should appoint a committee to control the drainage. These points were elaborated in the report, it being remarked that all plants in Ontario, 150 in number, do not turn out more than a reasonable capacity for one good sized plant; that the under drainage of but half a very small township is being accomplished each year, and that it is imperative that some-

thing should be done to speed up the work of under-drainage within the province.

Select Fire Brick for the Service it is to Render

At the afternoon session, Mr. W. H. Grant, ceramic engineer of the Elk Firebrick Co., Hamilton and Buffalo, read a paper on "Use of Firebrick in the Steel and Clay Products Industries." After a description of the mining of clays and the manufacture of fire bricks, Mr. Grant went into details of the bricks required in the three departments of the steel industry, blast furnace, open hearth, and rolling mill. In the clay products industry the fire brick requirements and uses covered largely power plants, dryers, and kilns though in some operations additional equipment was required. He emphasized the desirability of using firebrick which were especially well adapted to the service in various parts of the kilns or furnaces instead of adhering to one grade only. Instances were not at all rare where so-called first-grade material failed utterly and third-grade material replaced it to a decided advantage both as to price and service. This called to mind the fact that the time honored custom of buying fire brick as first-grade, second-grade, and third-grade was fast losing prestige because nearly every fire brick made was a first-grade brick for some particular class of service, or it might be third-grade for others, and such failures as noted above were encountered occasionally because the first-grade brick for some purposes was not first-grade for the service in which it was placed.

Consumer Should Consider Requirements

After referring to the abuse in the handling and care of fire bricks, Mr. Grant dealt with the question of the manufacture of particular bricks for various requirements. Manufacturers, he said, had spent large sums in making a study of this problem, and were continually striving to improve the quality of their brick so that longer and better service might result from its use. On the other hand, however, the average consumer paid no particular attention to his own specific requirements. He used a No. 1 or No. 2 grade of brick and was apparently satisfied with the service without giving a thought as to whether a different type of brick might not answer the purpose better. When he bought brick he bought them as No. 1 brick and the manufacturer had no idea as to where they were to be used. In all probability, an entirely different brick would give just as good or better service at a lower price, but the manufacturer in not knowing the condition could not make recommendations.

The answer to this was co-operation. In ordering brick, the purpose for which it is used should be stated. Give the brick man some idea as to the fuel to be used, manner of stocking, whether by hand or machine, and the conditions of the draft, and he could probably offer a suitable brick without guessing at what should have been told in the first instance.

Mr. Greaves-Walker, of the American Refractories Co., Baltimore, expressed the opinion that in Eastern Canada the iron and steel manufacturers were using too high a grade of brick. He suggested that it was not necessary to use No. 1 brick except in the arches of the furnaces.

Brick as a Solution to the Road Problem

In speaking on "Pave with Bricks," Mr. W. P. Blair declared that both in Canada and United States the people would have to depend more and more upon the highways. Automobiles and trucks were increasing,

and they would be vital factors in solving the transportation problem. It is, he insisted, to the benefit of the community that they should build roads over which they can go instead of the mud holes through which they are compelled to go and sometimes fail. Mr. Blair recounted a number of incidents with a view to showing how the commerce of the country is retarded and how much produce is wasted by the lack of good roads. He emphasized the fact that brick, tile, fire brick, etc., manufacturers have made a mistake in not carrying their knowledge as to the use of their materials to the user. Some progress has been made, but much leeway has to be made up. No part of the craft has been more guilty than the paving brick people. Years ago the brick people sold their product and said "good-bye" to their customers. These bricks were sold without regard to the various conditions of the district. It is essential that, instead of investigating the unit of what the materials are made, they should inquire what are the problems attending the use of the road. The last thing that they fail to do is to drain the road bed. If they drained their road beds so as to keep them dry they would have a good wearing surface. There can be no question that brick roads can be constructed which will last longer, haul more stuff, and give more service than any steam road than can be built. A brick road, properly constructed, is more economical, where traffic is excessive, than any road constructed of other material.

A discussion followed as to the relative merits of brick and concrete. Mr. Blair strongly advocating the use of brick, Mr. T. H. Graham pointed out that the advantages of concrete were consistently and widely advocated, and it was for this reason that brick roads were not more general in Canada.

"Machinery and Dryers for Large Size Tile" was the subject of a paper by Mr. L. Haigh, of the American Clay Machinery Co.

Gathering Data About Loads on Brick Piers

A paper on "Brick Tests and Investigations," by Mr. W. W. Pearse, city architect of Toronto, was submitted. This was published in the "Contract Record" of February 19th, 1919, page 151. The secretary read a letter from Mr. Pearse, in which he stated that the bricks used were donated by the Don Valley Brick Co. These bricks were really what might be termed discards, although the Don Valley Brick Co. wished his department to take a better class brick. "I thought it well to conduct tests on the poorest type of brick that would be at all likely to come into the Toronto market," stated Mr. Pearse, "and you will note that the test of the individual brick only developed the crushing strength of 1,000 pounds per square inch. I hope to have brick piers tested this year of which the individual bricks will develop about 2,000 pounds per square inch; also brick piers the individual brick of which will develop approximately 4,000 pounds per square inch. In both these cases the piers will be the same length as previously tested, and as recorded in my paper. If I am successful in having these tests conducted I believe that Toronto will have the best data for figuring brickwork of any city on the continent, for it is evident that it will be very easy to interpolate between the 1,000, 2,000 and 4,000 bricks for any intermediate grade of brick. I hope by this means to be in a position to entirely revise the chapter on brick work in our present building by-law, and expect thereby to be able to save a considerable sum of money for the citizens who are using bricks. I would appre-

ciate it very much if you will kindly get an expression of opinion of the brick manufacturers assembled in Montreal as to the poorest grade of brick that they think should be allowed to be used in the Toronto market. My opinion is that a brick developing a crushing strength of less than 2,000 pounds per square inch should not be allowed to be used. I would draw your attention to the schedule which I have given of the crushing value of the different bricks coming into the Toronto market, and you will note that only in a few cases did the bricks develop a value less than 2,000 pounds per sq. inch in compression; and I am therefore of the opinion that if a minimum of 2,000 pounds per sq. inch be taken it would work a hardship to no one." It was decided to refer the request of Mr. Pearse to the executive committee.

Newly Elected Officers

The election of officers was the first business at the second day's session of the convention. The following were elected: past president, Mr. T. Kennedy, Swansea, Ont.; president, Mr. W. Burgess, Todmorden, Ont.; first vice-president, Mr. R. H. New, Hamilton; second vice-president, Mr. M. F. Gibson, Toronto; third vice-president, Mr. T. H. Graham, Inglewood; secretary, Mr. G. C. Keith, Toronto. The councillors are Messrs. Andrew Dods, Mimico; J. S. McCannell, Milton; F. B. McFarren, Toronto; C. B. Lewis, Toronto; C. A. Millar, Toronto; W. H. Freeborn, Brantford; N. T. Gagnon, Montreal; H. H. Hallatt, Chatham.

Following the election of officers the following papers were presented:

"Burning of Carbonaceous Clays," by Mr. J. Keele, B. Sc., chief engineer, ceramic department, Mines Branch, Ottawa.

"Steam Shovel Comparisons," by Mr. William Burgess, superintendent of the Don Valley Bricks Works, Toronto.

"Motor Trucks in the Clay Products Business," by Messrs. C. Harrison, of the Dominion Sewer Pipe Co., and Horace Harpham, of Commercial Cars, Limited, Toronto. This was read by the latter.

"Sewer Pipe Investigations," by Mr. Arthur G. Daltzell, consulting engineer.

Question Box

The Question Box was the opening item at Wednesday's session. Answering a query as to whether oil was as cheap as coal for fuel in brick plants, Mr. A. F. Greaves-Walker stated that in Canada coal was cheaper than oil, notwithstanding the saving in labor in operating with the latter. The installation of oil was expensive, but the oil was easier to handle.

Replying to a question as to whether there was any chance of brick ever being sold by weight, Mr. Greaves-Walker stated that there was a great deal of discussion on this question in the States. Selling by weight was undoubtedly the fairest proposition, but it was really up to the brickmakers to make a move in this direction, if they decided to sell by weight, the thing would be done. His own firm had sold by weight for some time, and it had worked out well, although the purchasing agent at first objected. It was decided to refer this question to the executive committee.

A discussion on producer gas followed, Mr. Walker pointing out that the success of the plants all depended upon the quality of the coal. It was essential to use coal which would give good gas.

With regard to the swing pulverizer, it was of value on hard shale, but it was no good for soft clays.

Considerable discussion took place on the compara-

tive cost between the producer gas continuous kiln and the coal fired continuous kiln. Mr. Walker stating that the losses in gas fired kilns were entirely due to faulty design and bad workmanship.

Mr. Philip Dressler, of the American Dressler Tunnel Kilns Co., New York, described by means of diagrams the firing of clay products in the Dressler continuous muffle kilns. They were designed, he said, to establish a heating curve for different kinds of ware, each of which had its own characteristics. The distinctive feature was the distribution of heat, the kiln being in the form of a continuous tube. From a constructional point of view the kiln was unlike any other muffle kiln in that the muffle was distinct from the kiln. It was claimed that the kiln gave conditions which enabled makers to turn out a better grade of ware than was possible with intermittent kilns.

The last paper was by Mr. H. P. Timmerman, Industrial Commissioner, C. P. R., on "Drainage of Farm Lands."

Entertainment Features

The Montreal entertainment committee, Messrs. L. W. McArthur, (chairman), Hector Desjardins, N. T. Gagnon, T. A. Alexander, and A. J. Robinson, made very satisfactory arrangements for the entertainment of the delegates. The plans included a theatre party on the night of May 26th, and a drive to the top of Mount Royal, with a luncheon, on the afternoon of the following day. On May 28th, the delegates were shown around the harbor, visiting the grain elevators and proceeding to the limits of the harbor in a tug. The dinner was held on the evening of May 27th at the Queen's Hotel, and was largely attended.

Ground Water Disintegrates Sewer Pipe

Investigations into Causes of Internal Incrustation and Scale on Machine-Made Pipes—Paper Presented at Canadian National Clay Products Convention

By Arthur George Dalzell, A.M.E.I.C., M.R.S.I.*

THE City of Vancouver began to use machine-made concrete pipe in the year 1909, and up to the end of 1917 had laid probably over ten miles of this class of sewer pipe in sizes from 8 to 30 inches in diameter. The specification upon which the contract for the supply of this pipe was based was as follows:

"All cement concrete pipe supplied under this contract shall be the very best of machine tamped pipe manufactured. They shall be composed of a mixture of portland cement and fine crushed granite, or portland cement and clean, coarse, sharp sand or fine gravel. Sufficient clean water is to be used in the mixture to insure its thorough hydration. The inside or the wearing surface of the pipe shall be trowelled by the use of a revolving metal core until it presents a polished or glazed appearance. The pipes must be capable of withstanding an inside hydraulic pressure of thirty pounds per square inch for fifteen minutes, and pipe when placed in an upright position and filled with water must be sufficiently non-porous to retain ninety-five per cent. of the water for twenty-four hours. Each pipe must not be less than two feet in length, and of not less than the following thicknesses: 4-inch, $\frac{3}{4}$ -inch; 6-inch, $\frac{7}{8}$ -inch; 8-inch, 1-inch; 10-inch, $1\frac{1}{8}$ -inch; 12-inch, $1\frac{1}{4}$ -inch; over 12-inch, not less than one-eighth of their diameter. Pipes 18 inches in diameter and under are to have spigot and socket joints, similar to those specified in Clause 11 for clay pipe; those over 18 inches in diameter, grooved and tongued joints of approved pattern."

No stipulation was made as to the proportions of the materials entering into the construction of the pipe, as it was considered best that the manufacturers should be responsible for their product. It is, however known that the proportion of cement in the pipes hereinafter described was not less than one of cement to three of aggregate, though the manufacturers afterwards made pipe which they claimed to be of superior quality, with the proportion of one of cement to five of aggregate.

*Consulting Civil Engineer, Vancouver, formerly Assistant City Engineer of Vancouver.

Larger Sizes Examined

In the year 1915 some pipe of 12 and 14 inches in diameter, which had been laid in 1913 as temporary outlets pending the construction of a trunk sewer, was taken up and found to be so fragile that it was impossible to use it for relaying elsewhere. This led to an examination of other sewers, but as the small sizes could only be looked into where they entered large trunk sewers, a more thorough examination was confined to sizes over 20 inches in diameter.

The conditions found in two sewers, one of 24 inches laid in 1910, and carrying combined sewerage from a residential section, and one of 27 inches, laid in 1909, carrying storm water only, are here described.

For examination of the 24-inch sewer the sewage was blocked off and pumped from a manhole into an adjoining sewer on another system. Two lines of fire-hose were used to flush the sewer, which had a grade of one per cent., and a rope was floated down by which a small bogie carrying the observer was pulled through the sewer, the hose being kept running.

Previous observation on large defective pipe, and examination from the trunk sewers of some small-sized pipe which showed a stalactitic deposit on the crown, caused attention to be directed at first to the crown of the sewer. It had only been entered a short distance when the bogie jammed through the piling up of material in front of the wheels, and the observer had to be pulled back.

Heavy Incrustation on Inner Surface

The sewer maintenance foreman then volunteered to go through the sewer without keeping the hose running, so as to locate and remove the obstruction. In the dry sewer it was seen that the obstruction was not caused by sand or road debris left in it, but on each side of the sewer at the level of the ordinary dry flow, about four inches above the invert, there was a thick incrustation of material which looked very much like lime mortar, and that the wheels of the bogie broke this material, and formed the obstruction. It was also found that in spite of the prolonged flushing in the endeavor to cleanse the sewer for examina-

tion, paper and sewage still adhered to the rough edges of this incrustation.

A 27-inch sewer carrying storm water only was then examined, and similar conditions found; so that it was evident the incrustation was not caused by sewage. Many other sewers of the same class of pipe were examined, and it was found that the presence of this incrustation was most marked where the pressure of ground water was most evident. In one sewer where the pipes had been laid in tunnel and covered with coarse concrete, incrustation was only found at one or two joints; and in sewers built of concrete in situ, the same thing applied, the continuous scale on the water line of the sewer being peculiar to the machine-made pipe.

The sewer maintenance foreman had often told the writer that the concrete pipe sewers took longer to flush clean than the vitrified pipe sewers; and if incrustation of the character herein described is general in the smaller sizes, the reason is obvious. In the 24-inch pipe carrying sewage, the obstruction to flow was most marked. This must tend to make a foul sewer and lead to the formation of sewer gas, which in itself is prejudicial to concrete and will tend to shorten the life of the sewer.

Examination to Determine Cause of Incrustation

Charles A. Newhall, of the Charles A. Newhall Co., Inc., chemical and inspecting engineers, of Seattle and Vancouver, had described to the Pacific North-West Society of Engineers, in Seattle, the results of his investigation in several concrete-lined railway tunnels, and the effect on the concrete of the percolation of ground water and the gases from locomotive fuel. He was invited by the writer to examine these sewers to see if the cause of the incrustation could be found, and his report, in part, is as follows:

"We herewith submit to you the result of our investigations on concrete sewer pipe laid in Georgia St. and Glen Drive, Vancouver. Concrete pipe in stock and samples removed from sewer were also examined.

"The Georgia St. sewer was entered from a manhole west of Jervis St. With the aid of a rope and dolly the writer was pulled through the sewer towards Jervis St., and thus was able to make a personal and thorough examination.

"This sewer has been in place about eight years, and has been used only to carry storm water. The pipe is 27 ins. diameter inside, smooth finish; pipe said to be machine made, with a mix of one volume cement to three of crushed granite, with enough water to give a semi-wet consistency. Judging from the inside appearance, the pipe was of good quality and made with care.

"We found that the lower side of the pipe, through practically the entire length of the sewer examined, was coated to a varying degree with a stiff, firmly adhering scale. In places this scale had formed to a depth of three or four inches, these thick deposits being made up of several layers lying parallel to the surface of any water that would flow through the sewer. In places the thick scale would be cut through along the flow line of the sewer water, and only the edges and lower layer of the scale remained firmly adhering to the concrete pipe. In other places the scale had evidently just started to form or had been mostly scoured away, as only a slight roughness and coating

was noticeable on the concrete bottom and sides of the pipe.

Scale at the Joints

"In some sections, especially at the joints of the pipe, a thin scale or encrustation of somewhat different appearance than that just described was noted. This encrustation extended in streaks from the top or sides of the pipe down to the bottom, the surface of the encrustation being parallel to the inner surface of the sewer pipe. This encrustation in places was white in color and in others of a dirty grey color. It adhered very firmly to the surface of the concrete pipe. The concrete of the pipe was firm and hard on the inside surface. There was no softening noticeable under any of the encrustations or scales.

"The Glen Drive sewer was entered by the manhole at the intersection of 11th Ave. and the examination made on the section extending toward 12th Ave. The pipe carries the sewerage from a residence section and was in use at the time of our inspection. The sewer was rather foul and gassy hence we did not deem it wise to go up into it, but made our examination from the bottom of the manhole into which the pipe opened. With the aid of a flash light and a long pole we were able to make a thorough examination of the surface for a distance of ten feet up the sewer. In this ten feet encrustations and scale similar to those noted in the Georgia St. sewer were observed.

"This sewer has been in the ground about seven years; is a 24 in. inside diameter; said to be machine made, of a one to three mix, but gravel and sand instead of crushed granite.

"A section of the Glen Drive sewer had previously been taken up for examination and one of the pipes removed was examined in the city yard. This pipe was 24 in. diam., 24 in. long and 3-in. wall.

"The inside of the pipe showed a thin coating of scale on the lower or flow side; this scale being similar to the scale noted in the two sewers examined. Also a white encrustation was noted in the pipe, this encrustation extending from the high side of the pipe down toward the flow side.

"The inside of the pipe, aside from the encrustations, showed a good smooth concrete finish. The outside surface of the pipe had been pitted in places and softened to a depth of $\frac{1}{4}$ in. to $\frac{1}{2}$ in. below the original surface. In these soft places the remaining concrete was so loose that it could be quite easily scraped away from the surface.

"Samples were taken of the thick scale from the Georgia St. sewer, the scale from the bottom of the Glen Drive sewer, and the white encrustation from the Glen Drive sewer.

Analysis of Scale from the Georgia St. Sewer

"A green-grey scale, quite firm and coherent when wet, but turning dirty white and chalky when dry. The scale, when examined under the microscope, is found to consist of quartz and rock sand, wood shreds, organic matter and a very fine amorphous material like the "laitance" or scum that forms when portland cement is hydrated with too much water.

"This amorphous material binds the sand grains together. It is strongly alkaline towards phenolphthalein indicator, thus further establishing its similarity to hydrated portland cement. Fine clay, very fine sand or organic matter—all substances that might possibly be the binder which holds the sand of the scale to-

gether—would not give an alkaline reaction with the above indicator.

"When the scale is thoroughly dried, it becomes quite chalky and it is possible to rub the coarse sand from the amorphous binding material. An analysis of the fine proportions (which comprises 53 per cent. of the weight of the scale) shows as follows: Silica and sand (insoluble matter) 72.74 per cent.; iron and aluminium oxides, 2.48 per cent.; calcium oxide, 6.77 per cent.; water and carbon dioxide, 10.52 per cent.

Scale from Glen Drive Sewer

"Similar in general appearance to above. It contained shreds of lint and paper in addition to other substances noted above. Its analysis was: Silica and sand (insoluble matter), 72.74 per cent.; iron and aluminium oxides, 5.30 per cent.; calcium oxide, 10.50 per cent.; water and carbon dioxide, 11.40 per cent.

Encrustation From Glen Drive Sewer

"This material contained a small amount of very fine sand, together with wood and paper shreds, lint and organic matters; silica and insoluble matter, 21.54 per cent.; iron and aluminium oxides, 2.48 per cent.; calcium oxide, 30.94 per cent.; water and carbon dioxide, 41.02 per cent.

"In these three samples the point of interest is the calcium oxide content. The sand portion contains no soluble calcium compounds. Samples of soil along the line of this sewer had already been examined by a reputable firm of chemists. From a study of their report it is certain that the calcium compound could not have come from the soil or ground water. All this gives the clue to the origin and cause of the scale and encrustations.

"Now it can be easily demonstrated that as weak an acid as carbonic will decompose cement, provided enough fresh surface is exposed to the action of this acid. Hard, sound, neat cement pats can be dried and finely powdered. This powder can be exposed to the action of water containing carbonic acid. Eventually all the calcium oxide of the cement will go into solution as calcium bi-carbonate.

Ground Water Dissolves Cement

"All soil water contains organic acids, among which is carbonic acid. Thus if ground water should seep through the walls or joints of a sewer pipe the calcium oxide of the cement would gradually pass into solution and eventually the pipe would disintegrate.

"Just this thing is happening in all the concrete sewer pipe where the encrustations and scales are appearing. Ground water and sewer water gradually dissolve the cement and carry the calcium oxide into solution as calcium bi-carbonate. This water charged with the calcium bi-carbonate, and the scourings of the hydrated cement from the walls of the sewer, unite to form a normal calcium carbonate which binds the cement scourings, sand and other float in the sewer into a fairly hard scale.

"The cement pipe itself furnishes the binding medium whereby any sand and float is held in the sewer, i.e., the calcium bi-carbonate which is formed from the solution of the calcium oxide of the hydrated cement.

Can Obtain Non-Porosity

"In a large heavy wall sewer or a thick mass of concrete, even if quite porous, the dissolving action of ground water will take place, but this point should be noted: Disintegration will stop just as soon as the flow of ground water through the concrete is stopped.

In any sewer pipe or a mass of concrete, this flow of water will depend strictly on the head of the water and of the porosity or void space of concrete. If the flow is rapid and the cement is dissolved and disintegrated before the silt and mud flowing along with the ground water plug up the pores, the concrete will go to pieces.

This is the reason, we believe, why a porous drain tile will sometimes give good service when laid in clay soil, but a similar tile will go to pieces if laid in peat or sandy soil: The fine particles of clay plug up the pores of the concrete and keep the soil water away from the cement.

"Thus a thin walled cement pipe stands a far greater chance of being destroyed by ground waters than does a heavy walled pipe or a massive concrete wall. For this reason more trouble is to be expected with the small size pipe, say 30 in. and under, where the wall is thin.

"It is entirely possible to make a concrete pipe that will meet this requirement of non-porosity if enough cement is used, or if a water-proofing medium is used, and if extreme care is taken in curing. A mixture of one part of cement with two and one-half parts of carefully graded sand would be none too rich. With a 1 to 5 mix, or a 1 to 3 mix, even if most carefully mixed and placed, it is absolutely impossible to get a moisture-proof concrete.

"Even with a well-made, dense concrete, there is, in the light of recent investigations and reports, a strong presumption that percolating waters will enter the concrete mass and eventually cause deterioration. In our investigations of concrete railway tunnel linings we noted numerous cracks and fine fissures in the mass of dense, sound concrete. These cracks and fissures can only be formed by natural expansion and contraction due to temperature changes and to alternate wetting and drying of the concrete mass. Such movements are inherent in the nature of a substance like concrete, made up as it is of a mixture of crystalline fixed aggregates bound together with a glue-like colloidal substance.

Once these cracks and fissures are formed, percolating waters gain entry and disintegration is bound to take place to some extent, the damage depending entirely on the amount of surface exposed by the cracks and fissures. Ordinarily in massive concrete the cracks quickly become plugged up by infiltrating silts and by the products of disintegration and little or no damage is done. However, if the cracks or fissures occur in thin walls such as of small size sewer pipe, the concrete is likely to fail before disintegration can be checked by the natural causes.

Conclusions

"1.—A troublesome scale and encrustation is forming in the concrete sewers of Georgia Street and Glen Drive.

"2.—The concrete sewer pipe in these two sections is subject to conditions that will eventually cause its disintegration.

"3.—The scale and encrustation are caused by accumulations of sand, sewerage matter and scourings from the walls of the concrete pipes, these materials being held together by calcium compounds derived from the cement of the pipe itself.

"4.—Percolating ground water and sewerage water are gradually passing through the pores of the cement pipe, the carbonic acid contained in these waters dissolving and disintegrating the cement of the concrete."

"Macadam, Mileage and Maintenance"

The Policy That, According to the Author, "Means More Miles and More Service to More People for the Money Invested"

By A. P. Sandles*

UNDER the folds of Britain's flag was rocked the cradle of John Louden Macadam. He was the founder of macadam roads. The vast domain of British Empire can well be proud of this illustrious citizen who climbed to a lofty place among the sons of men. He blazed a new trail that nations and progress have followed. Wander where you will, in the world, if civilization is there, macadam roads are there. Yonder, across the border, John Louden Macadam has hold of the four corners of my country, the United States, and is lifting us out of the mud and mire. "His body lies moldering in the grave, but his soul is marching on."

Mr. Macadam was Road Commissioner of Scotland for fifteen years—from 1783 to 1789. Before this time he visited America. After that he began working out his "Macadam Plan." Those eminent highway engineers, Arthur H. Blanchard and Henry D. Drowne of Columbia University, New York City, say in their text book on Road Making:

"Macadam was the first man to recommend a broken stone surface of very small size stone for public roads. Other great engineers helped him to work out and demonstrate the success of his method. He proved there was great difference between a loose stone road and a perfect Macadam road."

As a tribute and monument to a useful man, the world has built more miles of Macadam Type roads than it has of all other types combined. The "Macadam Plan" was the result of years of study and experiment by a man who devoted his life to the work. His plan has borne well for a century. The novice or amateur road builder who presumes to discredit this noted road maker, gets but little applause. Macadam type roads appear in different forms, wearing different surface coats, to meet the needs of modern travel. Mr. Macadam is the man who helped us to jump from oxcart to tin-lizzie and from mud-boat to motor truck. He is the man who clove back the darkness and beckoned us to our place in highway transportation today.

Macadam roads are the most used and most abused of any form of highway improvement. They are usually built and then murdered. Lack of maintenance is a crime and a disease. If there is any one place where the old adage, "A stitch in time save nine" fits best, it is in the care and repair of roads.

Macadam and Maintenance

The good road secret is "Macadam and Maintenance." When our overseas fighting lads were marching to meet or overtake the Hun, they had both feet on Macadam-Victory roads. These world-war veterans will go on the witness stand and testify that the Macadam and Maintenance roads program over there made the Hohenzollerns sign the armistice before breakfast and sign the peace treaty as it is written in the language of John Louden Macadam and the Republic of France.

No permanent road is made. Such theory violates

natural law. Mountains slowly but surely wear away. Petals of the rose fade and fall. Every thing, animate and inanimate, has its zenith. Then come decline and decay which forever play a part. This natural, immutable law never has been and never will be repealed. It is in force on every mile of road that has been or will be made. Until the sun is cold, this law will hold. In days long gone, a king inscribed over his castle door this legend "Even This Will Pass Away." In his sadness, the legend was a hope and cheer. In his gladness, it was a caution and a halt on revelry. Kings and castles pass away, but the law of the legend over the door, like Tennyson's Brook, goes on forever.

He, who proclaims "permanent roads," should commune with nature and learn the error of his ways. The roads of Rome, the Appian Way, the Roads of Caesar in France, were builded of stone, centuries ago and are wearing yet. They more nearly approach permanence than any other structure ever built by man. Constantly newspapers record the fact, that the so-called permanent roads fail to meet the test of time, speed, modern loads, and weather. No matter what the type of road, the patrol man must be on the job if the road is to be kept at 100 per cent. every day in the year.

Repair Increases Resistance

Mr. Macadam won a splendid victory, when he invented a road on which repair would strengthen its wearing capacity and add to its power of resistance. He wisely avoided a type of construction, on which repair would be a weakness. He had in mind quick mending, no traffic delay, and small cost. Macadam builded better than he knew. The fame and name of this uncrowned king reaches round the world. After a century of time, the ways and wisdom of this great engineer, still umpires more miles of road making than all the others combined.

God made no mistake when He hauled and unloaded stone in convenient places for the use of man. Macadam knew this. He used material near at hand. Macadam is the natural cure for mud roads and bad roads. The supply of material will never be exhausted. Maintenance is the secret. One of the distinguished jurists and judges of Ohio has aptly said, "to neglect to build good roads is a blight on a nation, but to neglect to maintain them is inexcusable and a criminal waste of public property."

Roads must be well built. Ignorant, careless or fraudulent construction robs the public pocket book. Brains in the engine room of the engineer, honesty in his heart, and full knowledge of road making, will make this official a public benefactor. Hats off to him who makes the blue print and writes the specifications which guide the workmen in building and erecting great structures. Without the engineer and architect, the world would go back to chaos. The highway engineer must know his business and have the courage to umpire his game. He is a power house. His office must be beneath his own hat. A public policeman ought to be on the job to insure faithful performance

*Secretary, National Crushed Stone Association, Columbus, Ohio, before Canadian Good Roads Congress.

of contract. If this safe-guard is neglected any and every type of road will be a disappointment.

Drainage is Life Insurance to the Road

A crown on a road is worth more than a crown on a Kaiser. Drainage is the corner-stone of road making. Drainage is life insurance to the roof and root of the road. Surface drainage is essential. Foundation drainage is the alphabet of every road improvement. Maintenance is the father and mother of good roads. Mud-holes are cancers. Road-ruts a disease. Dust a pestilence. Breaks and cracks mean danger and damage. The patrol man and surface treatment are safety-first money savers. Some day we may build road vehicles so that rear wheels are wider apart than the front wheels. This will distribute the weight and wear of loads over a greater surface and lessen the chance of rut making.

The good road secret is "Macadam and Maintenance." Macadam means more miles and more service to more people for the money invested. Nations of Europe, after centuries of experiment and experience build Macadam roads. Mileage is popular. Rightly built and repaired without delay are the pass word and countersign.

The business of road officials is to spend money not to save money. They should make supreme effort to give the tax payer value received for every road dollar invested. They should build roads for the benefit of road users and not for the purpose of making any man or set of men rich. Material men, contractors and politicians are entitled to a square deal and nothing more.

The good road sentiment is a tidal wave. It must be honestly and intelligently met and answered. If at any time or place, there is greed, grab or graft in road-making, it should be hit and hit hard. Road officials will do well to be wary of the fellow who wants to show them a good time. That fellow expects to grind his own ax and chop his own wood with it.

Excess profit should be hand-cuffed and straight-jacketed. If any set of men attempt to manipulate under-ground wires to make enough profit on one job of work in one road-building season, to enable them to retire and live at ease the rest of their natural life, they should be straight-jacketed and the contract held up until honesty and square dealing can be written into the records of the road improvement. Road officials should give these shysters and Shylocks a publicity shock and a chance at hard labor.

Bad Roads Take Men From the Farms

Bad roads lessen religion and increase profanity. The man who must live on a mud road all his life, wont have any fear of hell. He will be used to it. Bad roads induce farmers to leave the farm. Mud-roads for the many and joy-ride boulevards for the few is hardly a healthy national road policy. The good road should reach as far as the flag goes. It should reach as far as conscription of men for the battle line reached. The rural country homes that gave a boy to war service, should have the hope of a good road, some day. There should be system. Main highways should be established. Co-operation between units or divisions of government should be the rule in road making. This will avoid patch-work and crazy-quilt, disconnected road building. But, the meal-ticket growers should be neither neglected nor forgotten.

John Louden Macadam intended that road building should have an economic value. Farm and food high-

ways will give the consumer more crop for his dollar and give to the producer more dollars for his crop. This double-gear gain off-sets and pays off the road tax. The shortest distance between producer and consumer is a good road from farm to market. Investigation discloses the fact that the average yield of fields increases when improved highways are built into an agricultural community. The good road does social up-lift work. School, church and government improve under the influence of a modern highway. Again, these blessings off-set and pay the road tax. The good road is Dollars and Sense. This means common sense, not copper cents.

Mileage, Macadam, Maintenance

How can everybody have the hope of a good road? How is the farmer to be served. How will rural folks be reached? France and other nations of Europe have answered these questions. Boil the story down and the answer is made in three words, viz: Mileage, Macadam, Maintenance.

In Ohio, my home state, the average cost of roads, per mile, sixteen feet wide, in 1918, as shown by the records on our State Highway Department was as follows:

Water-Bound Macadam	\$16,000
Bituminous Macadam	19,000
Concrete	31,000
Reinforced Concrete	32,700
Brick—Stone Base	38,000
Brick—Concrete Base	51,000

These were war prices. The average Ohio prices, before the war, 1914, were:

Water-Bound Macadam	\$8,657
Gravel Macadam	8,365
Bituminous Macadam	11,064
Concrete	14,227
Brick	20,982

As a rule Macadam roads are wider than other types of roads. This should be kept in mind in comparing general cost price. While the allied armies were going to the front over Macadam roads, the meat-wheat meal-ticket over-here was going to the front over hard-top highways over here. Mr. Macadam was a blessing at both ends of the line. We must have road mileage without bankrupting the public money-box.

When war came, railroads failed to meet the crisis. The throat of traffic choked. Terminals clogged. Freight congested. Huns laughed and rejoiced at our predicament. The motor truck appeared as saviour. Brains, mixed with lightning and gasoline, make wonder wagons. The motor truck became an engine of war. Day and night it delivered millions of tons of freight and armies of men, on time at the right place. The world knows that the motor truck was a crusader in the world war. The world knows that the motor truck would have been helpless without the hard-top road. John Louden Macadam began one hundred years ago, to build Victory Roads that were to humble the haughty Hun and make the Kaiser run from Hunland to Holland. "God moves in a mysterious way, His wonders to perform." Roads are the scaffolding by which nations are built up and saved when they have to be saved. Macadam, Mileage and Maintenance make possible the following editorial comment in Collier's Weekly:

Extent of Auto Service

"Auto-passenger mile service is greater than all our railways combined, and greater than all our elec-

tric traction service. It is almost equal to steam and trolley passenger service combined. The ten-mile service of commercial motor vehicles compares favorably with railway short-haul freight."

Macadam, Mileage, and Maintenance will make the motor truck even more useful in peace than in war. In one Ohio county are 900 miles of Macadam roads. Eighty-five per cent. of its people live on or within half mile of a hard top road. The engineer resurfaced old road beds and saved tax payers \$11,000 per mile. It is economy to save old road beds where possible and reasonable.

In the United States, farmers are leaving the farm. This was true before the days of war and abnormal wages in shop and factory. As secretary of agriculture in the state of Ohio, I asked 4,200 farmers by letter, to give me their reason for this folk-flow from farm to city. The answer that out-numbered all the rest was "Bad roads or mud-roads." No nation can go on forever jamming its population into skyscrapers, city flats, tenement houses, and centres of population. High cost of living is no accident. Good roads will help to keep farmers on the farm. This is safety first. Bolshivism does not flourish on the farm. The Red Rag Flag gets no applause or color bearer among country folks. The red-light danger signals flash their warning from the city, not from God's great out-of-doors.

The biggest men, the best minds, and the ablest

statesmen must hold the helm on the ship of state, if great nations are to endure. Your country and mine will be most secure and content, if we do those things that will keep a normal percentage of our people outside of the city. Again, Macadam, Mileage, and Maintenance are the panacea. Roads for the many, not alone for the few. Good roads are never a menace. Good roads cost less than bad roads.

Macadam-Victory Roads made thrones crumble and crowns tumble. John Louden Macadam helped to paint the picture of Hun battle ships in the North Sea floating a white flag and surrendering Germany's sea power forever to the allied powers. Macadam helped to write the greatest chapter in human history and in human liberty. Macadam has set the makers of geography to the task of re-charting the world.

It costs more to live to-day than ever before, but it's worth more to be living now than ever before. The peace treaty and the League of Nations will not settle all questions, but they will settle the Huns. Britain, France and the United States have not always drunk from the same canteen, but when we fought together on the fields of France and Flanders we forged a mighty link in friendship's chain, which I hope will be never broken. We dedicated and consecrated Macadam-Victory Roads to peace on earth and to the brotherhood of man. In lands where God and the Golden Rule hold sway, there the name of John Louden Macadam will be applauded and applauded forever.

Efficient Operation of Steam Shovels

Style of Machine to be Selected Gauged by Work It Has to Do—
Efficiency in Handling Depends on Pit Men and Shovel Operators

By William Burgess*

NO doubt one of the most important factors in the modern methods of handling brick clay has been the development of the electric or steam-driven shovel. This development has been measured by the requirements of the brickmaker, and has kept pace with the constantly increasing demands of economy and efficiency. In this connection it is interesting to note that within the last twenty years the operating capacity of the largest shovels has been doubled. This increase has been gradual.

Shovel Suitable for Work it Has to Do

Experience has fully proved that whatever is feasible or desirable from a commercial or economic standpoint can be built from a mechanical standpoint—the size and design of the shovel are dependent upon the kind of work it is wanted to perform. To ensure its profitable employment you must select a type of shovel suitable for your own bank or conditions of clay pit. In 1903 the Don Valley Co. bought a shovel of about 25 tons weight, short boom for their wire-cut clay bank, which is about 65 feet in height. This shovel was always in trouble, either through clay falling on it because it was too close to face of the bank or through breaking its stiff-legs or mast by heavy work. After three or four years of almost continuous repairs and trouble, we decided to make a change, and after looking around several brick plants, decided to get a 75-ton shovel with a 40-foot boom. This shovel has given

entire satisfaction and repairs have been very small. There has been no falling of clay on the shovel, no breaking of stiff-legs, 75 per cent. less dualin is used in shooting the bank down; the craner and shovel runner are in no danger from falling clay; and more pleasant working conditions obtain generally.

The small shovel was removed to our upper clay bank or buff clay, which is about 21 feet high, where it has been very satisfactory, digging as much as 200 cubic yards of clay in 9 hours. The machine does not break its stiff-legs, and the clay does not fall on the shovel, because the bank is about the right height for it to reach. We have to loosen the bank up on top occasionally by using dualin.

Economy Can be Effected by Proper Track Layout

The comparison seems to prove that it is very essential to get a steam shovel which is right for your clay bank. We thought our 25-ton shovel was useless while on a 65 bank, but when put on a 21 ft. bank, it was just as useful as the 75-ton shovel is on the high bank. Track shovels used for railway constructions are generally built to railway gauge so as to run on any railway track. Shovels used for highways, canals, brickyards and other work are mostly wide tread wheels, using heavy plank under the wheels where the clay is soft, but my experience has taught me that rail tracks are the best for brickyard work. Both of our shovels are about 9 ft. gauge; cutting a solid level track is very essential for the proper working of the shovel. We make track by first laying

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stringers lengthwise of the shovels, then cross fills 8 in. by 16 in. every 4 ft. 6 in. centre to centre with two pieces 4 in. by 6 in. oak bolted on each end, and about 24 in. apart, in which we place a timber or sill 12 in. by 18 in. by 9 ft. long, and drive wedges between the 4 x 6 in. blocks on the 8 x 16 in. timbers to hold the 12 x 18 in. sills in place. On the top of the 12 x 18 in. timbers we spike 80 lb. rails 9 ft. long, or in other words, each section is 9 ft. long. We use the same kind of section on the small shovel, using smaller timbers. This style of section takes a lot of timber, but on bad bottoms it saves a great deal of trouble. Economy is effected by the use of track of this type, as compared with a track of ordinary construction.

Clay Bank Men Contribute to Efficiency of Shovel

The timber used should be tough and hard, the former quality prevents splitting, and the latter prevents rails from sinking in the wood, when curving the shovel to get different cuts on the bank. Competent clay bank men contribute greatly to the effective and satisfactory moving and operation of the shovel. One of their most important duties is the proper levelling and compacting of the bottom, preparatory to the laying of the track section for the move up. If this work is not done properly, the track will take an irregular bedding, which tends to increase the wear and tear upon the track section, and also produces irregularities in the working function of the shovel. Allowance must be made for the settlement of soft spots in the clay.

Turning movements are commonly effected by a series of forward and backward movements, by which the alignment of the shovel gradually changes to the position required. It is well to give your section considerable curve when changing the alignment of the shovel. The possibility of accidents in turning is not appreciably increased provided the movement is executed with reasonable judgment and care.

Much Depends on Shovel Men

The mixing of the different strata of clay in your bank is a very important matter, in the operation of the dipper. Clay varies widely in the different layers or strata, and their proper mixing makes a great difference in the quality of your brick. Here again, a great deal depends upon your shovelmens. In all dipper and boom operations, the operator should aim to eliminate excess movements which cause loss of time and energy. The most common sources of losses are failure to properly adjust the elevation and distance locations of the dipper during the operation of swinging in readiness for delivery to cars or other transport vehicles; failure to release the dipper door immediately upon reaching position for the delivery of its load; failure to have the dipper in a position from which the thrust and raise movement can immediately be begun; and failure to stop the upward movement of the dipper immediately upon the completion of the filling operations.

The successful operation of the shovel depends upon the energy, skill and brains put into the work by the shovel runner and his craner and the care which they bestow upon the engine and other operating parts is a most important factor. Those men recognizing that a working shovel is the mainspring of their job will be constantly upon the lookout for improperly adjusted gears and bearings, and also for loose nuts and broken bolts. They will "listen for knocks," knowing that a loose bolt will cause a knock, and that a loose nut left unattended means a stop. If, by chance, the stop materializes through ordinary and unavoidable

wear and tear, they will endeavor by the exercise of trained intelligence to make such temporary repair as will permit the operation of the shovel until such times as permanent repairs can be made without a complete tie-up of the work. Reckless operation frequently takes the form of a sudden application of a retarding or stopping force, or a too generous thrust of the dipper, with the result that the operating parts of the shovel are subjected to excessive stresses and uncalled-for abuse. Naturally, the operating costs will be augmented as the result of breakdowns and repairs.

The writer thinks that a steam shovel is one of the most essential machines in a brickworks, if you only have an output of 20,000 or 25,000 bricks per day.

Mr. William Burgess, the New President of the Canadian National Clay Products Association



Four deputations asking for road improvements recently called on the Hon. J. A. Tessier, Provincial Minister of Roads, in Montreal. One requested that a highway be built between Hull and Montreal; another wanted the continuation of the St. Lambert-Levis road; a third asked for the completion of the Salaberry road, and a fourth desired the construction of a trunk road between two roads already built in St. Valentin.

The city of Outremont has received 26 plans from 11 competitors for the competition for houses, the prizes being nine of \$150 each. The Quebec Association of Architects objected to the competition on several grounds.

A committee representative of the Montreal Board of Trade, Chambre de Commerce, the Administrative Commissioners, and other bodies, including municipalities, has been appointed to promote the construction of a bridge between St. Anne's & Vaudreuil, at a cost of \$300,000.

A Treatise on Hot Mix Asphalt Pavements

Foundation and Subgrade Considered—Mineral Aggregate Requirements
—Plant Efficiency—Construction and Properties of Various Types

By Francis P. Smith, Ph. B.*

IN pavements of this kind both the mineral aggregate and the bituminous cementing material are first heated, and while hot, are then mixed together. They differ from the so-called penetration type of pavement, in which cold stone in place on the road is given a surface application of hot bituminous binder, by having a better graded mineral aggregate and a far better and more uniform coating of bitumen on the mineral particles.

Bituminous pavements differ from each other chiefly in the size and kind of the mineral aggregate, the bituminous cement or binder being substantially the same in each case.

Depending upon the size of the mineral aggregate used, bituminous mixtures may be considered as bituminous mortars or bituminous concrete differing from ordinary mortars and concretes, in having a cementing material which is plastic and which may be classed as a semi-fluid or a semi-solid. For this reason greater care must be taken in the grading of the mineral aggregate, in order to insure the requisite amount of stability, than if a rigid cementing material were employed.

Ideal Surface for Mixed Traffic

It is generally conceded that the ideal surface for mixed traffic is one which is slightly malleable (approaching sheet lead in this respect) as this will minimize wear and noise. A pavement which is too soft and mobile will be objectionable as it will rut and displace easily, and offer too great resistance to tractive effort. Too hard a pavement will be noisy and unless it is very tough, will wear away rapidly, and if monolithic, will be liable to more or less rapid disintegration through expansion or contraction. If jointed, to overcome this, continuity of surface and smoothness of riding is lessened and disintegration at the joints is liable to occur. Malleability precludes extreme rigidity, hence a malleable pavement will be low in bridging strength and will require a rigid foundation. The ideal pavement would, therefore, appear to be one in which the foundation and wearing surface were separate and composed of materials differing very widely in their properties, and provision should be made for renewing the wearing surface when necessary without disturbing the foundation. All bituminous pavements are to a certain extent malleable and yielding, thus minimizing the wear of the mineral particles and making them more acceptable to horse drawn traffic. In summer these qualities are more noticeable than in winter, for at very low temperatures the asphaltic binder becomes practically rigid. Bituminous pavements, especially those with fine mineral aggregates, are smooth, non-absorbent and easy to clean. They are capable of sustaining very heavy traffic and also last well under light traffic. They are therefore well adapted for business and residence streets, and the facility with which they may be kept clean makes them especially desirable in tenement districts. They are easy to re-

pair without disturbing the base and offer but slight resistance to traffic. When dry and clean they are not slippery and their slipperiness in moist or drizzly weather is largely due to the presence of a thin film of mud caused by the collection of street detritus and this can be greatly reduced by washing or keeping them clean. For this reason they are less slippery in a heavy rain than in a drizzle. The size of the mineral aggregate determines the character of the surface, i.e., whether rough or smooth, and from the wide variety of them it is almost always possible to select one type which will satisfactorily meet any given set of climatic and traffic conditions. Bituminous pavements therefore come nearer to being the universal and ideal type of pavement than any other which has yet been devised by man.

Flexibility Demands Stable Foundation

The very desirable quality of flexibility possessed by bituminous pavements makes it necessary to provide a stable foundation. If the foundation is unstable and sinks after the pavement has been put down, the pavement will gradually sink with the foundation, thus forming a depression in which water will collect and eventually destroy it. The wheels of vehicles passing over such depressions will drop into them, the force of the blow depending upon the weight of the load and its speed, and this will still further exaggerate the depression by forcing up a portion of the pavement immediately in front of it. It will also set up a vibration in the springs of the vehicle which will cause successive blows to be dealt to the pavement until the spring vibration returns to the normal. This action, especially in commercial vehicles, where the springs are short and stiff, results sooner or later in wave formation which is unpleasant to ride over and which, when it once sets in to any considerable extent, rapidly increases until it becomes necessary to resurface the street or road. The same effect will be produced on a rigid foundation when the bituminous pavement is lacking in stability, due to a poorly graded mineral aggregate, too soft or too much bituminous cement, or a combination of these.

The character of the foundation required will depend upon the traffic, climate, character of subsoil and drainage conditions. The heavier the traffic the stronger must the foundation be. In cold climates where the ground freezes to considerable depth in winter, the spring thaws produce a very unstable condition of the subsoil and in such cases the foundation must be stronger than is required in climates where there is little or no frost. A well drained sandy soil is much less affected by these temperature changes than is a heavy clayey soil. In all foundations, drainage is by far the most important single consideration. With adequate drainage, a much thinner foundation can be laid than where it is absent or imperfect and the cost of proper drainage is often far less than the added cost of an adequate foundation on imperfectly drained ground.

A number of different types of foundations have

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been successfully employed, such as old macadam or Telford; broken stone rolled dry or cemented together with some form of bituminous cement; old cobblestone, Belgian block or granite sett pavements; old brick or asphalt block pavements; bituminous concrete; natural cement and Portland cement concrete.

Old Foundations Prove Useful

Where the traffic is light, as on country roads which are not main arteries from or between large cities and in some residential streets, old macadam or telford roads have proved to be suitable foundations for bituminous surface mixtures. In the opinion of the speaker, telford is preferable to macadam owing to the fact that the larger stones composing its base have a partial slab effect and therefore resist more strongly any pressure tending to displace them or to force them into the subsoil. In some cases, notably the Thames embankment in London, a macadam foundation covered with an asphalt pavement has successfully carried heavy traffic but the layer of stone has been built up during many years and is very thick and the drainage is nearly perfect. Under very severe conditions the use of macadam or telford as a foundation for bituminous pavements is to be deprecated and more failures than successes have resulted from it.

Many roads are classified as macadam which contain no base course of large stone and are in reality old dirt roads which have never been properly drained and on which fine stone has been dumped and consolidated by traffic. Before using any macadam road as a foundation, its history, and more particularly its condition in the spring of the year, should be investigated. A sufficient number of test holes should be put down to determine the character and depth of the stone and provision made for proper under and side drainage. It will usually be necessary to rebuild the road in a number of places and in most instances the crown must be reduced. Wherever possible this should be done by filling up the depressions and building up the shoulders. Traffic will compact a road far better than will a roller and a road surface which has been scarified and rolled will not be as hard and firm as one which has been compacted by years of traffic. Where depressions are to be filled or shoulders are to be raised, the roadbed should be cleaned and slightly loosened to insure proper bonding of the new stone which should be of the same size as would be employed in building up the corresponding portion of a new macadam road. It should be thoroughly wetted and rolled with a 10-ton road roller with the addition of sufficient screenings until vehicles passing over it do not cause displacement. Unless this work is thoroughly and conscientiously done, the foundation will not be of uniform strength throughout, and settlements will occur where the new stone was put. If it is necessary to scarify the road surface, this should be done to the minimum possible depth, after which the surface should be built up exactly as if constructing a new macadam road and rolled until the utmost compaction is obtained. Wherever possible traffic should then be turned upon the road for a few months to develop any weak spots in it, and to secure still better compaction.

Old pavements of brick, granite, etc., should not be used as a base if it is first necessary to re-set them. In their original condition they are satisfactory if the traffic is not too heavy. Relaid blocks, until bedded by traffic, are not rigid, and have a tendency to rock,

and asphalt pavements laid on such foundations in New York City have rapidly disintegrated wherever they were exposed to heavy traffic.

Bituminous Concrete as a Foundation

Bituminous concrete is sometimes employed as a foundation. One of the best types of it is made of run of the crusher stone from 2 in. down to dust, so graded and mixed with sufficient sand as to make a fairly dense and rigid mixture carrying about six per cent. of asphalt cement. When this is kept clean and the wearing surface laid upon it at once, no binder course is necessary. It has less bridging strength than portland cement concrete and should only be laid on firm, well drained subgrade and is not suitable for very heavy traffic. It is usually laid from 4 to 6 inches thick. It has a number of advantages over Portland cement concrete. It is very slightly subject to expansion and contraction cracks and the overlying bituminous wearing surface if properly laid adheres to it very strongly, increasing its resistance to displacement under traffic. It is also water-repellent and underlying moisture will not be sucked up through its pores and attack the bottom of the wearing surface. This is a frequent and serious cause of disintegration of bituminous pavements laid on portland cement concrete foundations where through imperfect drainage or unavoidable conditions the ground water level or layer of permanently water-saturated earth lies close to the top of the subgrade.

Portland cement concrete foundations vary according to conditions from 4 to 9 inches in depth and in every case before laying them the subsoil should be thoroughly compacted and drained. In certain localities in the northwestern portion of the United States and Canada, very heavy clay soils are found, which in winter frequently develop cracks 4 to 5 inches in width and heave very badly. In such cases cross trenches should be dug every twenty-five or thirty feet, and filled with coarse broken stone and connected with longitudinal trenches at the side of the street, similarly filled and draining to catch basins. Concrete should not be laid directly on such a soil. Sand or gravel should first be spread upon it to such a depth that when rolled it will form a layer 3 to 4 inches in thickness and the concrete should be placed on this. Under rapid temperature changes cement concrete foundations are liable to crack. When the cracks are large, the overlying bituminous wearing surface frequently cracks in or near the same place. Where the foundation cracks are small, the wearing surface is usually not affected by them. Rich, dense concretes are more liable to crack than leaner mixtures and the speaker advocates for foundation work a monolithic structure composed of a rather lean mixture, not richer than 1:3:5. Transverse expansion joints in the concrete are not altogether satisfactory as cracks in the pavement are liable to occur over them and if the joints are filled with a bituminous filler, cut off flush with the top of the concrete, this filler is frequently shoved up through the top of the wearing surface. If the filler is cut off about 1 inch below the surface of the concrete, it will not be forced through the pavement but the joints at best create an area of concentrated stress in that portion of the pavement immediately overlying them, which tends to rupture it. In addition to a lean concrete, the obvious remedy is to thoroughly drain the subgrade.

Having briefly considered the questions of founda-

tion and subgrade, we now pass to the wearing surface. This is composed of mineral aggregate and bituminous binder. The mineral aggregate constitutes from 80 to 90 per cent. of the pavement, and takes practically all the wear resulting from traffic. It must therefore be selected with great care. It must be hard enough to carry the traffic; it must have clean grains or particles to insure the bitumen adhering to them, and these grains or particles must be graded from coarse to fine so as to make a pavement of the maximum density, with the smallest sized voids obtainable and with sufficient inherent stability to resist displacement under the shoving action of traffic. The surfaces of the grains or particles must be of such a character that the bituminous cement will adhere satisfactorily to them. Earth, sand, gravel, broken stone or slag, and finely ground limestone or portland cement or combination of them, are the materials used in the type of pavements under discussion.

The Various Materials

Earth.—This is used in a special type of pavement which has been developed within the past five years. It should be of such fineness that at least fifty per cent. of it will pass a 200-mesh sieve and it should contain from 15 to 70 per cent. of clay, depending upon its character. This material requires a special kind of plant to handle it.

Sand should be clean grained, hard and moderately sharp. The grains should be chiefly quartz and should have rough pitted surfaces. Where necessary, the proper grading of the different sized grains must be obtained by mixing several sands or in certain cases by the addition of unweathered crusher screenings. When using the ordinary type of bituminous mixing plants the presence of clay is undesirable, either as a coating to the grains or disseminated throughout the mass. For medium or heavy traffic pavements all particles retained on a 10 mesh screen should be discarded. For light traffic, three to five per cent. of 8 mesh particles can be incorporated in the pavement with advantage or broken stone of the sizes and in the amounts described under "Topeka Mixture." Sands containing a large amount of flinty grains should be avoided as bitumen does not adhere well to flint.

Gravel should be clean grained, hard and free from adhering clayey particles. It is lacking in stability owing to its roundness and is usually considerably improved by passing it through a crusher. Gravel with a rough pitted surface is to be preferred and gravel containing a large percentage of flinty particles is to be avoided. It is unsuitable for the construction of pavements carrying heavy traffic and inferior in all respects to crushed stone.

Broken stone should be freshly crushed, preferably in cubical shaped particles. The size and hardness required depend upon the traffic which the pavement is to carry. Dense hard limestone will carry medium and light traffic satisfactorily. Where the traffic, even though comparatively light in volume, is composed of heavy iron-tired units, a dense hard trap is required. Trap is now commonly used in the manufacture of asphalt block, although in the past a large number of asphalt blocks made from limestone gave excellent service under light traffic. Granite is not usually satisfactory as it is too coarse and uneven in texture and much of it is friable and it is liable to shatter in crushing. Mesh composition or grading

of the various sized particles is just as important as with sand. It is not suitable for use in pavements carrying very heavy traffic.

Slag.—Hard, dense basic slag is to be preferred. It should be stable when exposed to the weather and not show any tendency to slack or disintegrate. It is only suitable for light traffic and should preferably be coated with a very fluid bitumen.

Filler.—This should be finely ground limestone or portland cement, the latter being preferable for mixtures designed to carry extremely heavy traffic. For light traffic the speaker prefers the limestone dust, as it does not have such a marked drying effect. Which ever is used, it should be ground so that at least 65 per cent. of it will pass a 200 mesh sieve. Pulverized clay also makes an excellent filler but is difficult to handle owing to its tendency to ball and cake if it becomes the least bit damp.

Bituminous binder, or asphalt cement, as it is termed in the sheet asphalt industry, must possess such properties that it will firmly bind together the mineral particles and resist the disintegrating action of traffic and the elements. The necessary tests for determining whether or not it is possessed of these properties are fairly well standardized and are embodied in most standard specifications. The time allotted the speaker will not permit a detailed discussion of them. The consistency of the bituminous binder varies somewhat with the type of mineral aggregate, but otherwise its general characteristics are about the same for all types of the pavements under discussion.

The Manufacturing Plant

The plant used in the manufacture of the paying mixture is a very important element in the success of the pavement. The standard type of plant first developed in the sheet asphalt industry has for a long time been recognized as the best for the purpose. In it the sand or stone, or both, are heated in revolving driers and fed by means of elevators into a storage bin. The bituminous cement is heated in properly designed melting kettles.

Measured or weighed (preferably the latter) amounts of the various ingredients are then mixed together in a twin shaft mixer of the pugmill type. This mixer should have a speed of from 65 to 85 revolutions per minute and for ordinary work each batch should receive a full minute's mixing. Where the service conditions are very severe it may be necessary to increase the time allowed for mixing and also to raise the temperature at which the mixing is done in order to insure a thorough coating of the surface of all particles with a firmly adherent film of bituminous cement. Great care must always be taken not to overheat either the mineral aggregate or the bituminous cement, as this will injure and harden the latter. Too low a heat will result in imperfect coating of the mineral particles. Certain asphalts are fluid at much lower temperatures than others and certain asphalts are very readily injured by overheating, while others are not.

Plants of the concrete mixer type, in which the heating and mixing are done in one revolving chamber, are not to be recommended. As usually arranged, they are inefficient mixers and are liable to burn the bituminous cement if the flame is permitted to come in contact with it. The only way to avoid this source of danger is to heat the bitumen and the mineral ag-

gregate separately and not to heat them in any way during the mixing process.

In the type of plant which we have been considering, clay or clayey particles are objectionable owing to the fact that they either become partly baked on the grains of sand or pieces of stone or form into lumps which do not detach themselves or break up under the action of the mixer blades. This prevents the bitumen from adhering to the grains or else results in coating the outside only of the clay balls. Under traffic these balls break up and the bitumen becomes detached from the coated grains, tending toward more or less rapid deterioration of the pavement.

In plants used for constructing pavements made of pulverized earth, the grains after heating are subjected to pulverization which breaks up any clay balls which may have been formed and which cleans the sand grains or small stone particles. Owing to the large percentage of water which clayey earths are liable to contain (three to five times as much as ordinary sand) these plants must have a much larger drier than ordinary sheet asphalt plants and they must be provided with a pulverizing device. The extreme fineness of the mineral matter necessitates a completely enclosed mixer box and special dust collecting device.

Four Distinct Types

Out of the raw materials which we have discussed, four distinct types of hot mix pavement are laid. They are as follows:

Sheet asphalt, in which the mineral aggregate contains no particles which would be retained on a $\frac{1}{4}$ -inch screen.

Topeka pavements, which usually consist of a standard sheet asphalt mixture to which has been added from 15 to 25 per cent. of stone passing a $\frac{1}{4}$ -inch screen and retained on a 10-mesh screen and approximately 10 per cent. of stone passing a $\frac{1}{2}$ -inch screen and retained on a $\frac{1}{4}$ -inch screen.

Bituminous Concrete Pavements (Bitulithic, Warrenite, etc)—having a mineral aggregate consisting largely or wholly of stone of varying sizes from 1 $\frac{1}{2}$ -inches down.

Pulverized Earth Pavements (National Pavement)—having a mineral aggregate composed wholly of pulverized clayey earth of such fineness that at least 50 per cent. of it will pass a 200-mesh sieve.

The following are typical analyses of the foregoing types of pavements:

	Sheet Asphalt Light Traffic	Sheet Asphalt Heavy Traffic	Topeka Mixture	Bituminous Concrete	Pulverized Earth Pavement
Bitumen	11.0%	10.5%	8.5%	7.0%	17.5%
200 mesh	14.0%	10.5%	8.5%	5.0%	55.5%
100 "	14.0%	10.0%	6.0%	4.0%	12.0%
80 "	13.0%	10.0%	6.0%	2.0%	6.0%
50 "	19.0%	14.0%	6.0%	5.0%	5.0%
40 "	11.0%	14.0%	10.0%	4.0%	3.0%
30 "	10.0%	13.0%	10.0%	4.0%	1.0%
20 "	5.0%	10.0%	9.0%	3.0%	.....
10 "	3.0%	8.0%	6.0%	5.0%	.....
8 "	.....	.....	6.0%	3.0%	.....
4 "	.....	.....	14.0%	7.0%	.....
2 "	.....	.....	10.0%	20.0%	.....
$\frac{3}{4}$ "	.....	.....	.....	14.0%	.....
1 "	.....	.....	.....	12.0%	.....
$\frac{1}{2}$ "	.....	.....	.....	5.0%	.....
	100.0%	100.0%	100.0%	100.0%	100.0%

Sheet asphalt will sustain a very heavy traffic.

This statement applies more especially to a traffic largely composed of quick moving, light to medium loaded vehicles, such, for instance, as prevails on Fifth Avenue, New York. It is not the most suitable type of pavement for a very dense, slow moving, heavily loaded, iron tired traffic. Wood block and granite block will outlast it under these conditions. It will not give satisfaction where there is practically a total absence of traffic, as it then is liable to develop cracks, apparently requiring the kneading action of traffic to equalize the stresses set up by contraction and expansion and to keep it in proper condition. It is entirely suitable, however, for traffic varying from the light delivery traffic of residence streets to the dense but quick moving traffic of Fifth Avenue, New York, or the Thames Embankment, London.

Examine Grades

On account of their smoothness, sheet asphalt pavements are not suitable for use on excessive grades. Generally speaking streets carrying a fair amount of traffic can be paved with asphalt if the grade does not exceed 6 per cent. In some cases where the traffic was very light and a smooth pavement was considered essential, it has been laid on grades running up to 10 per cent. and 12 per cent., but this is rather exceptional. Where the traffic is heavy, a 3 per cent. to 4 per cent. grade is usually considered as the limit. In most of the largest cities of the United States the maximum grades on which this type of pavement is laid vary from $4\frac{1}{2}$ per cent. to 8 per cent., regulated largely by the traffic and climatic conditions.

Generally speaking, the heavier the traffic, especially iron tired traffic, the finer should be the mineral aggregate used, owing to the fact that the coarse particles are more liable to fracture than the smaller particles. Where fracture takes place to any considerable extent, rapid deterioration of the pavement will ensue, as the bituminous cement ordinarily used is not sufficiently fluid at atmospheric temperatures to re-bond and re-coat the fractured particles, and these will quickly be pulverized and washed out, leaving depressions where water will accumulate and eventually rot the pavement. Where the traffic, even though heavy, is largely or wholly composed of rubber tired vehicles, a greater proportion of coarse particles is permissible and desirable. In proper proportions they add greatly to the stability of the pavement and under the conditions stated the light traffic mixture given in the table would be entirely suitable if the bitumen was increased to, say, 11 per cent.

Standard Construction

The standard sheet asphalt construction of the present day is one and one-half inches of binder and one and one-half inches of wearing surface. The binder should be of the "close" type, i.e., should contain approximately twenty per cent. of material passing an 8 mesh sieve, and approximately 15 per cent. each of $\frac{1}{4}$ -inch and $\frac{1}{2}$ -inch stone.

A close binder properly made and laid will be superior in many respects to the mixtures which have been laid on a large number of country highways and will carry a fair amount of traffic for a considerable time without suffering any serious damage. Poor binder will break up very easily—sometimes it can be kicked up—and the hauling of the hot surface mixture over it will damage it very seriously. Surface mixture laid on a binder of this kind which has been badly broken up might almost as well be laid on loose

broken stone and will not give satisfactory service under heavy traffic. The binder should, of course, be thoroughly compressed with a steam roller before laying the wearing surface on it. Lack of compression will produce an unsatisfactory foundation for the wearing surface; and binder which is too cold or made with too hard an asphalt cement or an insufficient quantity of asphalt cement can not be properly compressed into a dense, tough mass. In hauling the binder to the street over long distances or in very cold weather, it may become chilled below the danger point. During the hauling process a certain amount of surplus asphalt cement usually drains off of the stone and accumulates on the bottom of the cart or wagon. If these excessively rich portions be laid on the street, what are called rich or fat spots in the binder course will be produced. As the name implies, these are places carrying an excess of asphalt cement. If these are permitted to remain, the surplus asphalt cement will be absorbed by the hot surface mixture when it is placed over them. This will make a soft spot in the finished pavement which will be displaced by traffic and eventually produce a hole or depression in the pavement. They should, therefore, be cut out and replaced with normal binder.

Before laying the surface mixture on the finished binder course the latter should be dry and swept clean of dirt; otherwise the layer of wearing surface will not adhere properly to it. Binder should be covered with surface mixture as soon as practicable after laying it. In many large cities it is required that all binder laid should be covered the same day with surface mixture.

Spreading the Mixture

When delivered upon the street the surface mixture should be of such a temperature that it can be properly compressed and should be evenly spread by means of hot iron rakes. In many cases the loads of hot surface mixture are dumped directly upon the spot over which they are to be spread. This is bad practice as the men trample upon it while shovelling and raking it and the rakes do not thoroughly loosen up this trampled material when passing over and through it. Although the mixture is raked to a uniform surface and apparently even thickness before it is rolled, those portions which have been trampled on before and during raking are really covered with a greater quantity of surface mixture than those portions which have not been trampled on and which are covered wholly with what might be termed loose or fluffy mixture. When the roller has completed its work there will, therefore, be a slight unevenness in the finished surface. Under light traffic this would make no appreciable difference, but under very heavy traffic the slight pounding action resulting from this condition would be detrimental and lead to uneven wear of the pavement. Proper and thorough compression of the finished mixture is very essential as this produces a pavement which in its earliest stages is fit to sustain the heaviest traffic. It is always questionable whether portions which are very lacking in compression will be ground out or eventually consolidated. Under unfavorable conditions the chances are strongly in favor of their being ground out. In those portions of the pavement which are inaccessible to the roller, compression is effected by the use of hot smoothers or tampers, or both. If properly handled, the desired results will be obtained, but if used too hot they will burn the pavement and cause

it to scale or grind out. Hot smoothers particularly are dangerous tools to put in the hands of incompetent or careless workmen.

Making Joints

Extreme care should be taken to insure a proper union between the surface laid on successive days. The first loads laid in the morning at the point of termination of the previous day's work should be a little hotter than normal so that the hot mixture may soften the cold edge of the pavement and bond perfectly to it. The joint should be bevelled and freshly cut away unless the rope joint or a similar method is employed.

The practice of painting the edge of the joint with hot asphalt cement is not to be recommended, as unless extreme care is exercised, too much asphalt cement will be used and that portion of the pavement will be too rich in bitumen and consequently softer than the rest, which will result in uneven wear and possibly shoving. Great care should be taken not to leave any bump or depression where the joint is made.

Topeka Mixture pavements are laid from two to three inches thick and are frequently placed directly on the foundation. Much better results are obtained by using a binder course one and one-half inches thick next to the foundation with a one and one-half or two inch wearing surface. This greatly reduces the tendency of the finished pavement to shove. With a well graded mixture a squeegee coat is unnecessary although it is frequently employed.

The mineral aggregate as fed to the drier consists of a mixture of broken stone and sand which is liable to segregate in the bin. The hot aggregate should, therefore, be screened and separated into two sizes and kept in separate bins. Definite amounts of coarse and fine material should be weighed into each batch. Unless these precautions are observed, portions of the pavement will have an excess of coarse material and vice versa, and the normal bitumen contents for an average mixture will be too rich for the coarse portion and too lean for the fine portion.

The bitumen content of these mixtures is somewhat lower than for sheet asphalt and must be very closely watched and kept within much closer limits than are necessary with sheet asphalt mixtures. One-half per cent. above or below normal is about the permissible variation. Too little bitumen will make a pavement which is too open and porous and too much bitumen will render the pavement very liable to shoving.

Substantially Same as Sheet Asphalt

The general methods of manufacturing and laying and the precautions to be observed are substantially the same as for sheet asphalt. The surface of pavements of this type is somewhat rougher than sheet asphalt, thence they can be laid on somewhat steeper grades. They will normally carry a somewhat heavier iron tired traffic than the coarser bituminous mixtures, but not as heavy a traffic as sheet asphalt. Unless laid under very rigid and competent inspection, it is far safer to use sheet asphalt.

Bituminous concrete pavements, as previously noted, have a mineral aggregate consisting wholly or largely of stone of varying sizes from 1½ inches down. Some of them are made of run of the crusher stone and some of them (Bitulithic, etc.) are made of carefully graded aggregates. Where the aggregates are graded it is customary to separate the different sized

particles in from three to five bins and weigh out definite amounts from each bin for every batch. The normal bitumen content is lower than in Topeka mixture. An excess of bitumen will affect them in much the same way as a Topeka, but to a smaller extent. From two to three inches of the surface mixture are usually laid directly on the foundation. It is very difficult to completely close up such a mixture by rolling. It is usually therefore given a squeegee coat of hot bituminous cement, after which stone chips are spread over the surface and rolled in, the excess being left to be ground away by traffic.

National Pavement

Pulverized Earth Pavements (National Pavement) are usually laid without any binder coarse and from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in thickness. They are very rich in bitumen (15 to 20 per cent.) but are extremely stable and so malleable that at a temperature of 60-75 degs. F., a piece may be cut out of them and hammered back with a hammer and a perfect cold weld obtained. Their stability is due to the extreme fineness and absorbent properties of the mineral aggregate and for the same reason it is impossible to wear away the surface by any fracturing or grinding of the individual particles as they have been reduced to practically their ultimate state of fineness before incorporating them into the pavement. In many respects they resemble the old French rock pavements, which had an unequalled record for long life. As compared with the French rock pavements, they do not become polished under traffic but maintain throughout a very wide range of temperature, a consistency very closely approaching that of sheet lead, and as they contain from one and one-half times to twice as much bitumen, they are more waterproof and wear resisting. The clayey material of which they are composed has a much greater affinity for bitumen than any other known paving material, which still further adds to their permanence. With the exceptions noted under the discussion of plants, their manufacture and laying are very similar to sheet asphalt. A National pavement weighs about 170 pounds per square yard 2 inches thick, as compared to 200 pounds per square yard for sheet asphalt of the same thickness. Their cost is somewhat higher than sheet asphalt owing to the large amount of water frequently contained in the mineral aggregate and the high percentage of bitumen used in them. They are capable of carrying the heaviest kind of traffic and when properly constructed mark less in summer than do sheet asphalt pavements and are much less susceptible to shoving and displacement. They are equally suitable for very light traffic. The bituminous cement used in them is about 90 penetration at 77 degs. F., which is much softer than is used in other types of mixed pavements. For this reason they do not become hard and crack even if not subjected to traffic for a considerable length of time.

Discussion

The discussion on Mr. Smith's paper was opened by Mr. Drinkwater, who declared it to be a very excellent and conclusive document with which he agreed in almost every particular. The principal point brought out, he remarked, was the consideration of the type of pavement required for the traffic it had to carry. From his experience he had found that well-laid sheet asphalt pavements did not always give satisfaction if there was not sufficient traffic over them to keep them in good shape. In the laying of asphalt pavements, it

was absolutely necessary to have good technical and practical experience, else there is danger of a big waste of money. He had found that asphaltic concrete and sheet asphalt were not satisfactory for suburban roads where they were not confined on each side by concrete curbs, as they cracked in the winter and were forced open by the intermittent action of thawing and freezing, sometimes leaving bad cracks which could not be repaired without considerable expense. Stone filled asphalt was most suitable for light traffic streets and suburban traffic, and it was adapted to the climatic conditions in Canada.

With regard to gravel, Mr. Smith had mentioned that it was necessary to be crushed, but the speaker said he had found that a considerable quantity of asphalt pavement was built filled with gravel of a fairly large size. Out in Oregon they were building about one and a half million yards of pavement of this type.

The speaker questioned Mr. Smith regarding pulverized earth pavement, which Mr. Smith had stated had the advantage of being less slippery than sheet asphalt.

Mr. Smith replied that this type was very much softer and down to a temperature of 40 or 32 it was not as hard or slippery as sheet asphalt, but in temperatures below zero, such as they had in Canada, it would undoubtedly lose its resiliency.

Ontario's Highway Programme Goes Ahead in Spite of High Cost

In regard to Ontario's good roads' programme, Hon. F. G. Macdormid, Provincial Minister of Public Works and Highways, stated to the Contract Re-



Mr. F. G. Macdormid, Minister of Public Works for Ontario

cord: "The legislature at its last session approved a vote of \$5,000,000 in aid of highway improvement in the province of Ontario. The Department of Public Highways during the present season is carrying on important development work on many sections of the provincial highway, endeavoring to give good service to the public on this highway at an early date. Notwithstanding increased cost of labor and material, substantial progress is being made in improving the highways throughout the province.

New Rail Route to Western Canada

TRAVELLERS between Eastern and Western Canada are showing their appreciation of the high standard of railway service afforded by "The National," the splendid train which operates between Toronto and Winnipeg. "The National" uses the rails of the Grand Trunk to North Bay, the Temiskaming and Northern (Provincial Government Line) to Cochrane, and the Canadian National Railways to Winnipeg, where it links up with the Grand Trunk Pacific for all important points in Western Canada. A pleasant run to Toronto by the Grand Trunk and "The National" is ready to carry you westward. The departure of "The National" from Toronto is at 9.15 p. m. on Tuesdays, Thursdays and Saturdays. North Bay is reached early next morning and there opens up for your admiration all the lakeland beauties of the territory served by the T. & N. O. line, while the rich Cobalt and Porcupine districts may be inspected. These are followed by a wonderfully interesting trip through the sparsely populated territory of New Ontario, giving the traveller an opportunity of inspecting this fertile region, including the famed "clay belt" where tens of thousands of settlers will make their homes in the future. The area of New Ontario is 330,000 square miles, fully four times the size of Old Ontario, and in addition to great expanses of good farming land, it has wonderful resources in timber, minerals, water power, fish and game.

The three railways have combined to make the through passenger service over this new route the equal of that offered anywhere on the continent. The smooth, straight and level roadbed embodies all that has been learned in three-quarters of a century of railroad building. The greatest travel comfort is assured. The use of the new route involves no extra fare, as compared with any other route available, between points in Eastern and Western Canada.

New Shaft Sinking Record

A new world's record for shaft sinking was made in December, 1918, at the Crown Mines, Johannesburg, South Africa. The shaft is circular, having a diameter of 20 ft. inside the walling. During December it was sunk 279 ft. from a depth of 655 to 934 ft., the average speed being 9 ft. per 24 hours. The cost of sinking, exclusive of walling, was between \$62.40 and \$67.40 per foot for the month. The previous world's record also was made at the Crown Mines, where 252 ft. was made in a 31-day month at the No. 14 circular shaft of the mines; this was also a 20-shaft.

Russia Seeking to Re-establish Trade Relations with America

The representative in America of the Russian Social Federal Soviet Republic is seeking to re-establish trade relations between Russia and the American Continent. Nationalization of the export and import trade by the Russian Government places the entire foreign trade of the country in the hands of the Central Purchasing Institutions under the Department of National Economy in Moscow and of its representatives in foreign countries. The Russian Government will require the importations of American products in large quantities and is preparing to export large stores of raw materials which are ready for shipment. The government is prepared to pay for its purchases in a man-

ner which will make the trade independent of the depreciated value of the rouble and is ready to place \$200,000,000 in gold in banks abroad as soon as trade relations are established.

Big Irrigation Canal in British Columbia

The British Columbia Government's irrigation project in the Osoyoos district on land recently purchased from the Southern Okanagan Land Company has been announced. Ten miles of the main channel will be constructed this season on gravity principle, and water will be supplied from Okanagan river. It is estimated 300 or 400 men will be employed on this work, says a report from the Commissioner of Immigration, Winnipeg.

Trunk Roads in Quebec

The following trunk lines in the Province of Quebec have already been started, or are to be built in the near future: St. Therese Highway, 90 miles; Sherbrooke-Beauce Highway, 90 miles; Montreal-Laurentian mountain district highway, 60 miles; three Rivers-Richmond and Sherbrooke, 90 miles; Fraserville-Edmundston, N.B., highway, 76 miles; Montreal-Sherbrooke highway, 100 miles; Three Rivers-Shawinigan Falls and Grand Mere, 20 miles; and Levis-Fraserville highway, 123 miles.

Montreal-Hull Road

The Quebec Government have a full programme of road work for this summer. A main highway from Montreal to Hull, connecting the provinces of Quebec and Ontario, is to be started, Mr. E. A. Lessard, engineer of the Quebec highway department, being in charge of the work. Mr. Lessard states that three different highways between Montreal and the Ontario border will be started and pushed with all possible speed. Another highway to be commenced this summer is that which will run from Quebec City to Chicoutimi, along the river front for a considerable stretch, then through the Laurentian Mountains.

Exhibitors at Canadian Good Roads Congress

Firms represented by exhibits at the Congress were: Imperial Oil Co., Canada Cement Co., The Barrett Co.; Waterous Engine Works Co., Ltd., and Dominion Road Machinery Co., Ltd., represented by J. H. McCarty and Rene Talbot; Trussed Concrete Steel Co. and Canadian Fairbanks-Morse Co. There was also the interesting exhibit of the Ontario Highways Department, showing model sections of the various types of pavement. The Department has issued folders describing this exhibit.

Want Catalogs

The Builders' and Contractors' Association of Essex County, Ontario, is installing in its exchange rooms a complete filing department to contain catalogs and the latest literature on all supplies, machinery, etc., used in the general contracting business. The Association invites firms to mail catalogs, circulars or other information to 18 Ferry Street, Windsor, Ont.

The Regent Engineering Works have opened works at 4 Bronsdon Lane, Montreal.

Bastigan Bridge to be Built This Year

Hon. J. A. Tessier, Minister of Highways for the province of Quebec, has made a definite statement that the bridge over the Bastigan river will be built this year. The Bastigan river crossing is the only break in the continuity of the Montreal-Quebec highway. At the present time the sole means of crossing is by a single hand-propelled scow which can take only two motor cars at a time, each trip consuming half an hour. When traffic is heavy, motors are subjected to lengthy delays, while when ice is forming or breaking up, traffic has to be suspended completely.

Montreal Electrical Contractors Form Association

The electrical contractors of Montreal have decided to form an association to deal with labor and other questions. At a preliminary meeting, a committee was appointed to report on the basis on which the associa-



E. Gandiose Brousseau, president of the Quebec Builders' Exchange.

tion should be organized and to draw up a form of agreement with the employees. It was strongly urged that it was only by co-operative effort that questions affecting the industry, (such as the carrying out of electrical work by general contractors instead of through electrical contractors) could be effectively dealt with.

Earnings of P. Lyall & Sons Construction Co.

The net earnings of the P. Lyall & Sons Construction Co. for the year ended March 31st totalled \$1,314,582, a decrease of \$176,500. After payment of 8 per cent. on the common stock, the sum of \$114,236 is carried forward. Mr. W. Lyall, the president, reports that the company is experimenting with a view to developing new patent devices, and that the prospects are good for this business. Conditions in the building industry are slowly improving and prospects are encouraging.

The Canadian Domestic Engineering Co., Ltd., have removed to 255 Bleury Street, Montreal.

Mainly Constructional

East and West—From Coast to Coast

A general strike has been declared in Calgary in sympathy with the strikers in Winnipeg.

Excavating work on the new \$250,000 plant of the Wm. Neilson Company, Gladstone avenue, Toronto, has already commenced.

A proposition is under way to construct a highway from Montreal to the Laurentian Mountain district, a distance of some 60 miles.

A mass meeting of union men at Port Arthur, Ont., passed a resolution pledging their moral support to their brothers in Winnipeg.

The Ontario Department of Highways has taken over the Hamilton-Brantford and the Guelph-Owen Sound roads as provincial highways.

By-laws authorizing a big program of local improvements were passed by the town council of Arnprior, Ont., and this work will soon be commenced.

Elgin County, Ont., spent \$96,905.19 last year on road maintenance. It is anticipated that the work planned for this year will exceed last year's figures.

The estimated cost of construction work on additions to school buildings in the city of Toronto during the present building season is approximately \$500,000.

The Pioneer Soldiers' settlement Community have purchased some 7,000 acres in B. C. and will proceed to erect saw mills, residences and industrial plants.

The Board of Education, Campbellford, Ont., has asked the council of that town to issue debentures on a thirty-year basis for \$69,000 for erecting a new high school.

Extensive road work is to be undertaken in the district around Kingston, Ont., this year. The government intend spending \$64,500 in road building and purchase of additional machinery.

The town of Timmins, Ont., will shortly introduce a by-law providing for the organization of a Housing Commission. The proposed commission will consist of the Mayor and two other capable citizens.

Lincoln County, Ont., is building a new tar macadam road from Beamsville to Smithville, a distance of about eleven and one-half miles. Construction has already been started on Griffin street, Smithville.

The estimated cost of repairing the Wabasso dock at Hamilton, which was badly damaged by storms this spring, is \$40,000. The Board of Parks Commissioners will apply to the city for permission to issue debentures for this amount.

The Board of Railway Commissioners will sit in Ottawa on June 10th, when the Peterboro City Council's request for a grant toward the cost of changing the crossing grade for the high level bridge will be given consideration.

The Board of Trade of the city of Brockville, Ont., has passed a resolution authorizing the purchase of twenty-four acres of land, which is to be held for the building of factories. A number of American manufacturers are negotiating with the city for the establishment of new industries.

General Traffic Manager C. A. Hayes, of the Canadian National Railways, recently had a conference with the Board of Trade officials of the city of Fredericton, N. B., regarding the building of a new union station in Fredericton. Mr. Hayes expressed the opinion that when the C. N. R. estab-

lishes its new route from St. John to Montreal, via Fredericton, there will be sufficient traffic to warrant the building of a new station.

The Hollinger Consolidated Gold Mines Ltd., Timmins, Ont., will proceed with the erection of a number of dwelling houses for the accommodation of its employees in the town of Timmins. It is understood these houses will be erected at a cost of about \$2,200 each.

Major A. M. Jackson, who has recently returned from overseas to the work of engineer and road superintendent for the county of Brant, Ont., is constructing concrete pavement on several of the streets in the suburban area adjoining the city of Brantford.

The city of Montreal, it is stated, is shortly to have a new and very large sporting and theatrical edifice. The site selected is on the northwest corner of St. Lawrence Boulevard and Sherbrooke street. It is estimated the cost of the land and building will run up into the millions.

Construction work will be commenced this year on five C. P. R. lines in Saskatchewan: a line from Lanigan to Melfort, a line east from Vidora, a line south from Rosetown, a branch west of Mildred and a line connecting Archibald with Wymark in the country south of Swift Current.

Mr. Jno. McCallum, of Brooke, Ont., supervisor of Lambton's good roads system, gave an interesting talk on County good roads system at a recent meeting of the Chamber of Commerce at Petrolia, Ont. Mr. McCallum, by means of a county map thrown on a screen by a lantern, gave his hearers a clear idea of the county's plan of road improvements.

The city of Regina, Sask., propose expending \$98,201 on civic improvements this year. This amount is made up of the following: sidewalks, \$7,382.80; sewer extensions, \$243.87; sewage disposal works, \$4,607.50; sewer house connections, \$2,800.00; pavements, \$25,000.00; spur track crossings, \$10,480.58; water mains, \$7,686.25; light and power, \$40,000.00.

The Co-operative Elevator Company of Regina, Sask., are negotiating with the city for the purchase of land for the erection of twenty houses in the western part of the city, for their employees. The completion of this scheme depends upon the consent of the city to extend water, sewer and lighting facilities to this property. It is the company's scheme to rent these houses to their employees at cost.

The city of Montreal has offered free use of the equipment of the roads section to proprietors of lanes throughout the city for the paving of these lanes. The city's plan is to furnish the men, material and machinery for this work, doing the work in the most economical and satisfactory manner and charging the proprietors with the cost of material and labor but not for the use of the machinery. The city claims this is the only way these lanes can be kept in a clean condition.

Plans for the erection of a Peace bridge at Niagara Falls, in commemoration of a hundred years of peace between Canada and the United States, have been held up by the action of Governor Smith of New York, in vetoing the bills passed in the New York State legislature, providing for the appointment, by the Governor, of a commission of three to negotiate with the governments at Washington and Ottawa in relation to the matter. No reasons were given, unless it is because of the uncertainty in Canada as to where the Peace bridge should be located.

The municipalities of Sherwood, Pense and Moose Jaw, Saskatchewan, have decided upon a scheme for the purpose of determining the cost of road maintenance. Hon. S. J. Latta, minister of highways, recently met the Reeves, councilmen and secretary-treasurers of the three municipalities and discussed this question thoroughly with them and the fol-

lowing plan was adopted. The municipalities agreed to finance the work of putting the road between Regina and Moose Jaw in good shape. The provincial highway department will look after the maintenance of the road for the balance of the year, keeping the strictest watch on all maintenance costs. Mr. Latta explained how important it was that the highways department should be able to find out just how much it would cost to keep a reasonably long stretch of road in good condition. It is expected that this cost experiment will be of great value in the campaign for better roads.

Trade Incorporations

Toronto Sewer Pipe Company, with head office at Toronto, Ont., capital \$100,000.

Canadian Marble Quarries, Limited, with head office at Toronto, Ont., capital \$2,000,000.

Vancouver Rolling Mills Company, Ltd., with head office in Vancouver, capital \$25,000.

Canadian Tank & Pump Company, Limited, with head office at Toronto, Ont., capital \$50,000.

The King Street Building Company, Limited, with head office at St. John, N. B., capital \$49,000.

E. S. Stephenson & Company, Limited, with head office at St. John, N. B., capital \$18,000, to carry on business of iron founders, metal works, wood workers, etc.

Merlo, Merlo & Ray, Limited, with head office at Walkerville, Ont., capital \$40,000, for the purpose of carrying on the business of contractors, builders and engineers.

Acme Mechanical Engineering Boiler Works Company, Limited, with head office at Quebec, P. Q., capital \$149,000, to construct, repair and install machinery of every kind.

Dominion Plaster Board Manufacturing Company, Limited, with head office at Montreal, capital \$49,000, to carry on the business of wall board in plaster, asbestos, cement or other compounds.

Personal

Mr. R. S. McLaughlin, of Oshawa, has been appointed president of the General Motors of Canada, Limited, a new company with an authorized capital of ten millions.

A presentation was made by the Toronto waterworks distribution men to W. H. Randall, recent superintendent of waterworks distribution, on the occasion of his leaving the city's services to take charge of the Canadian end of the Neptune Meter Company, which is establishing a plant on Dufferin street.

Obituary

Mr. C. O. Graham, prominent Vancouver contractor and builder, died recently in that city. Deceased has been a resident of Vancouver for nearly thirty years.

John R. Long, well-known Hamilton contractor, met his death recently when his wagon was struck by a street car at the corner of Herkimer and Kent streets, and he was thrown under the wheels of the car.

Mr. Ernest Marceau, Montreal, superintendent engineer of canals in the province of Quebec, died on May 23 aged 66. had been in ill-health for some time. Mr. Marceau entered the canals service after graduating in 1877, and held the position of superintending engineer for many years. He took a considerable interest in the Canadian Society of Civil Engineers, holding several offices, including that of president. In 1904 he was appointed principal of the Ecole Polytechnique, Montreal. Mr. Marceau was a member of La Societe des Ingenieurs Civils de France.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Aylmer, Ont.

Town Council plans laying walks on Myrtle and Maple Sts. Engineer, W. E. Stewart.

Aylmer, Que.

Work will start shortly for street improvements for Town Council. Mayor, H. Therien.

Brantford, Ont.

Tenders received by chairman, Ald. Henry Simpson, until noon June 7th, for various paving for City Council. Engineer, T. Harry Jones.

Comber, Ont.

Township Council plans drainage work. Engineer, J. J. Newman, Davis Blk., Windsor.

Township Council plans tile drainage, \$60,000. Clerk, S. T. Anderson.

Coteau Landing, Que.

Plans and specifications are with sec-treas., Geo. N. Vernier, who is receiving tenders until June 16th, for construction of cement sidewalks for Municipal Council.

Dundas, Ont.

Tenders received by Chairman, A. W. Dreseke, until June 23rd, for construction of sewers, \$80,000. Engineer, C. R. Murdock.

Embro, Ont.

Tenders received by township clerk, Allan Murray, until June 9th, for 5,801 lin. ft. of tile with catch basins and concrete wall all complete.

Hamilton, Ont.

City Council plans construction of asphalt pavement, \$25,000. Engineer, E. R. Gray.

Hawkesbury, Ont.

By-law will be voted on June 15th, for \$75,000 for asphalt concrete pavements. Engineer, V. E. A. Belanger.

Kincardine, Ont.

Town Council plans construction of water mains. Secretary, R. Ross.

Pembroke, Ont.

Work has started for sewers, \$9,000, for Town Council. Acting clerk and engineer, W. A. Moore.

Plans are in progress for macadam paving, \$36,000, for Town Council.

St. Catharines, Ont.

Plans are in progress for sewage disposal plant and sanitary sewers, for City Council. Engineer, W. P. Near.

St. Cecile, Que.

Tenders will be called soon for construction of road for Municipal Council. Engineer, M. Henry, Roads Dept., Parliament Bldg., Quebec.

St. Valier, Que.

County Council plans construction of road from here to St. Camille, 66 miles. Sec-treas., Antoine Gagnon, St. Raphael.

Sandwich, Ont.

Plans are in progress for paving Centre St., \$45,000, for Town Council. Engineer, McCall & Fletcher, Gas Bldg., Windsor.

Wingham, Ont.

Town Council plans extensions to sewers. Clerk, John F. Groves.

Drainage system—Township Council has awarded contract to Wm. McMichael & Jos. Greenway, Bluevale, P. O.

CONTRACTS AWARDED

Laprairie, Que.

Road—Town Council has awarded contract to The Canadian Highway Engineering & Construction Co., 13 Place Guay, Montreal.

Ottawa, Ont.

Pavement, \$32,000—City Council has awarded contract to O'Leary Bros., Banque Nationale Bldg., Rideau St.

Asphalt pavement, \$30,000—City Council has awarded contract to Ottawa Construction Co., Central Chambers.

Quebec, Que.

Paving, \$135,000—City Council has awarded contract to Quebec Paving & Construction Co., 16—2nd Ave., Limoilou.

St. Constant, Que.

Bituminous macadam road, \$35,000, for Municipal Council: General contractor, The Canadian Highway Engineering & Construction Co., 13 Place Guay, Montreal, is in the market for asphalt.

Sarnia, Ont.

Sewers, \$9,000, and vitrified tile sewer—City Council has awarded contract to Webster Construction Co., York and Adelais Sts., London. Address, care of City Engineer, Sarnia.

Shawinigan Falls, Que.

Pavement—Municipal Council has awarded contract to Bellefeuille & Trepianier, Three Rivers.

Welland, Ont.

Sidewalks, \$10,000—City Council has awarded contract to Somerville & Dillworth, 12 Main St. E.

Railroads, Bridges and Wharves

Arkona, Ont.

Town Council plans bridge repairs and drainage improvements. Clerk, R. R. Crawford.

Deschaillos, Que.

Repairs to bridge, \$15,000, for Municipality: General contractor, Jos. Gosselin, 85 Dalhousie St., Quebec.

Fergus, Ont.

Concrete bridges for Wellington County Council: General contractor for Cormacks bridge, C. J. Callaghan, Arthur; Parker bridge, Phil McGowney, Arthur; McNabb bridge, John Langdon and A. Simmons, Drayton.

Ottawa, Ont.

\$150,000 bridge for City Council: General contractor, McDougall Bros., 320 Besserer St.

Repairs to iron bridge, \$15,000, for Municipal Council: General contractor, Jos. Gosselin, 85 Dalhousie St., Quebec.

Wentworth County, Ont.

Tenders received by R. C. Desrochers, secretary of Department of Public Works, Ottawa, until noon, June 20th, for reconstruction of 200 feet of pier.

CONTRACTS AWARDED

Arthur, Ont.

Steel and concrete bridge, \$6,500, for Township Council: Steel, \$5,500, Standard Steel Construction Co., Port Robinson; concrete, Emerson Simmons, care of Township Clerk.

Bright, Ont.

Blandford Township Council has awarded contract for bridge over Horner's Creek and concrete culvert on the 4th Concession to The Stratford Bridge & Iron Works Co. Ltd., Stratford.

Drumbo, Ont.

Blenheim Township Council has awarded the contract for concrete arch bridge, \$4,200, to Andrew Bain & Co., Embro. Engineer, Roger M. Lee, Brantford.

Blenheim Township Council has awarded contracts for abutments for bridge to A. L. Oatman, Tillsonburg, and the steel superstructure and floor, to Stratford Bridge & Iron Works Co. Ltd., Stratford.

Owen Sound, Ont.

The Grey Good Roads Commission has awarded the contract for new steel bridge, concrete floor, repairs to abutments and removal of old structure, to the Stratford Bridge & Iron Works Co. Ltd., Stratford.

St. Germain, Que.

Concrete bridge, \$4,000, for Municipal Council: General contractor, Ignace Bilodeau, 144 Ave. Renaud, Quebec.

St. John, N.B.

Reconstruction of wharf, \$28,500, for City Council: General contractor, Engineers & Contractors Ltd., 102 Prince William St.

Sarnia, Ont.

Two bridges for County Council: Concrete superstructure, A. J. Kirkpatrick, Petrolia; steel superstructure, Standard Steel Construction Co., Port Robinson.

Public Buildings, Churches and Schools

Brampton, Ont.

Plans are prepared for \$35,000 club house for Peel Veterans, Brampton Branch G.W.V.A. President Dr. Sharpe.

Campbellton, N. B.

Plans and specifications are with architect, F. Neil Brodie, 42 Princess St., St.

Contract Record

ESTABLISHED 1886

and Engineering Review

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Two Turbines for Ontario Hydro-Electric Development Will be World's Largest

THE largest capacity hydraulic turbines in existence will be the two being built by the Wellman-Seaver-Morgan Company, Cleveland, Ohio, for the new Chippawa development of the Hydro-electric Power Commission of Ontario. They will have a capacity of 52,500 h.p. each, when operating at 187½ r. p. m., under normal head of 305 feet.

The turbines will be of the single-runner vertical type, discharging downward into a single draft tube. The turbine casings will be of cast steel, of spiral form. The gates will be of the balanced wicket type, operated through suitable mechanism by a governor located on the generator floor.

The throat of the spiral casing leading to the runner will be spanned by a speed ring having ribs or vanes properly designed to direct the water to the turbine gates. The weight of the rotating turbine parts and the hydraulic thrust on top of the runner will be carried by a thrust bearing located on top of the generator.

All of the gate mechanism, except the gates themselves, will be outside of the water passages and acces-

sible for adjustment and repair. The runner will be approximately 10 ft. in diameter. The casing will have an inlet diameter of about 10 ft. and will discharge approximately 1,800 cu. ft. of water per second.

Apparent Increase in Business in U. S.

RECENT reports from all sections of the United States indicate that, after a protracted period of hesitancy on the part of consumers of construction materials, business is now steadily increasing. Building permits throughout the United States were 6 per cent. of normal in November, 1918; 10 per cent. in December; 20 per cent. in January, 1919; 40 per cent. in February, and 65 per cent. in March. This partial resumption of the construction business has not been accomplished by a decline in the prices of construction materials. Between October, 1918, and March, 1919, there was a very slight decrease in the prices of some commodities. Since March, prices in many lines have advanced. The composite index figure on 313 commodities given by Dun's Review was about 207 for October 1, 1918; about 197 for March, 1919; about 200 for April 1, and about 203 for May 1. The advances in prices of construction materials have in some instances exceeded this average, owing to the fact that the composite advance in the prices of construction materials was only 84 per cent. in November, 1918, as compared with an average advance in the prices of all commodities of 116 per cent. at that time.

C.P.R. Building Large Locomotives

TEN of the largest locomotives ever built for use on Canadian railways have been under construction for some time at the C.P.R. Angus shops in Montreal, and one of these, No. 5302, was inspected the other day by President E. W. Beatty and Vice-President Grant Hall. These locomotives are of the heavy Mikado type, and are intended for freight service, being classified and built under the direct supervision of Mr. W. H. Winterrowd, the chief mechanical engineer.

The weight of the engine and tender in working condition is 500,000 lbs., the engine alone weighing 323,000 lbs. The diameter of the driving wheels is 63 inches. The cylinders are 25½ inches in diameter by 32-inch stroke, which with 200-lbs. boiler pressure, makes these locomotives capable of exerting a maximum tractive effort of 36,000 lbs. The diameter of the boiler is 80 inches at the front end and 90 inches at the back end. The fire box is 84 inches wide, and 120 inches long, and the grates are moved by steam grate shakers.

The cab is of the vestibule type, which is the C.P.R. standard, and every effort has been made to make the accommodations for the enginemen as comfortable as possible. One side of the cab is fitted with a clothes locker, 14 inches by 20 inches wide, in which clothes can be hung and lunch pails carried. The tender has a capacity for 12 tons of coal and 8,000 Imperial gallons of water.

The Montreal Building Trades Labor Council have protested against the scale of fair wages adopted by the civic Administrative Commission as being below, in many instances, that paid by contractors in the city.

Machinery and Dryer for Large Tile

By L. Haigh*

IN the manufacture of large tile, we must take into consideration the fact that the manufacture is quite different from that of small tile. For small tile, a soak pit is located at the clay bank to prepare the clay. The clay is transferred from the soak pit and is put through a pair of rolls or crusher placed directly over an auger machine.

In making large tile, we find two processes largely used. In the first process, where the press is used in combination with an auger machine for smaller tile, the clay is put through the dry pans (the size of the pans being determined by the capacity of plant required). After leaving the dry pan, the clay is elevated and is passed over piano wire screens. The screens mostly used are 30 in. x 72 in. in size with openings between the wires of 3/32 in. The clay passing through the screen goes into a bin placed directly over the pug mill, while the large particles, better known as tailings, go back to the pan for regrinding. From the pug mill (which, of course, is the machine for getting proper plasticity of the material), the clay is elevated by a wet clay elevator to the press feeder and thence into the steam press.

Wet Pan Process Gives Better Results

The second process is where the press is used for large tile, but not in combination with an auger machine for small tile. The method of preparing the clay, which is gaining in popularity, is the wet pan process. As in the former case, the clay goes through the dry pans and screens, and then is put into a wet pan instead of a pug mill. Here the proper plasticity of the material is obtained. Then the clay is elevated by a wet clay elevator into the press feeder and thence into the steam press. It has been found that the wet pan process gives better and more thorough mixing than the pug mill process and has been largely adopted by the sewer pipe manufacturers, but both of these processes have proved very satisfactory.

Leaving the press, the tile are generally cut on a bow cutter. In most cases the smallest tile made by press method are 10 in. diameter. Tile up to 8 in. are generally made on an auger machine, placed on dryer cars and transferred to a waste heat or steam dryer. This system is possible, because, they are cut in single lengths, approximately 13 in. long, and do not have to be turned in drying. In the case of large tile, it has been found that the large slatted floor dryer, using exhaust steam from the press in day time and live steam at night, is by far the best method for drying, as the large tile are handled similarly to sewer pipes, each tile being placed on a pallet after leaving press, and handled by trucks designed for that purpose to take them to the dryer. These tile, as a rule, have to be turned in the dryer to insure satisfactory drying.

Dryer Building

A suitable dryer building for a plant running 150 tons capacity per day would be 80 to 100 feet wide, 280 to 300 feet long, and three floors in height. These floors are slatted floors, with steam pipes underneath the first floor and sometimes steam pipes are also plac-

ed under second floor. The tile on the third floor are dried by the heat rising from the floors beneath. The smaller size tile, 10 in. and 12 in., are generally handled without pallets and are loaded on platform trucks to be taken to the dryer. The 14 in., 16 in., and 18 in. tile are mostly handled on pallets, then placed on platform trucks to be taken to the dryer. The 20, 22, and 24 in. sizes always require pallets and are taken from the press one at a time and are conveyed to the dryer with a prong truck or side lift truck. The arrangement of tile in the dryer is generally as follows: The smaller tile, 10 and 12 in., are placed on the lower floor, 14 in. to 18 in. on the second floor, and the largest size tile on the third or upper floor.

The 10 and 12 in. tile, after being dried, are placed on platform trucks or wheelbarrows and taken direct to the kiln for setting. The larger sizes are placed one at a time on spring saddle trucks to be delivered to the kiln.

Setting Tiles in Kiln

The setting of these tiles in the kilns is a matter of great importance and the most practical method is to place the small tile at the bottom and the large tile in the centre and as near the centre of the kiln as is possible.

If bee-hive kilns are used, the tile are set as mentioned and when larger tile are set, it is of great advantage to place smaller tile inside of the large ones. This saves considerable space as well as making a safe setting throughout the whole kiln. The same setting holds good when set in a continuous kiln, the small tile being set two high in the bottom and the larger tile on top of these smaller ones, and then smaller tile are placed in the larger one, the whole being set up to the crown of the kiln. The writer, as might naturally be expected, prefers the continuous setting and burning on account of the saving in fuel and the saving in burning labor which is obtained by the continuous system. Better results are also obtained by the continuous method of burning, as the bottom tile are burned equally as well as those placed on the top, which is nearly impossible in the round down-draft or bee-hive kiln. The up-draft kiln is not satisfactory for the burning of large tile.

Over Two Millions Increase in Toronto Permits for This Year

The returns of the City Architect's Department, Toronto, for the month of May, 1919, show an increase in the value of the buildings erected for the year to date, over the same period of last year, of \$2,248,999. There were 311 more permits issued during the month of May this year than last year, and the total value for the month is \$1,455,734, being an increase over the month of May, 1919, of \$578,226. The total figures are as follows:

	1919	1918
Permits issued	929	618
Erections	1,146	757
Value	\$1,455,734	\$877,508
Value of business for year to date	4,983,950	2,734,951

A deputation of the citizens of Westmount, P.Q., have asked the Council to still further modify the building by-laws (which have been revised) in the direction of allowing apartment houses in districts closed to that class of building. The amended code makes concession in this direction, but they are not wide enough in the view of the deputation.

*Of American Clay Machinery Co., before Canadian National Clay Products Association.

Drainage System for Moore Park, Toronto

About 2500 ft. of 4 ft. 3 in. and 3 ft. 9 in. Two-ring Brick Sewer, all but 505 ft. of which was Laid in Tunnel—Detailed Costs of Operations

By W. G. Cameron* and R. W. Dickie†

WHEN the Moore Park drainage system in the city of Toronto was designed, provision was made for a storm-water outlet, the route of which was to be along Summerhill Avenue and Glen Road to the Rosedale Ravine. Construction of this outlet was commenced in November, 1917, and completed in February of the present year. The district in Moore Park, for which this outlet was provided, comprised an area of 233.5 acres, divided into two sections, the western and the eastern. The route of the sewer which served the former of these sections is along Summerhill Avenue, from Sighthill Avenue to Glen Road, while the route of the sewer serving the latter is down Glen Road North. These two branches meet in a chamber at Glen Road and Summerhill Avenue, and thence flow together through a larger sewer on Glen Road, to the Rosedale Ravine.

When the greatest precipitation in a given time and also the maximum run-off had been calculated, the sizes of the sewers were determined. For the western portion, it was decided that a sewer 3 ft. 9½ in. x 4 ft. 3 in. would be required; for the eastern portion a 24 in. pipe, and for the part down Glen Road from the point of junction of these two, a sewer 4 ft. 3 in. x 4 ft. 9 in. in size.

This work was let in two contracts, the first comprising that portion from Summerhill Avenue down Glen Road to the ravine, and the second the two sections leading east and west to connect with the outlets from Moore Park. In determining the best design, consideration had to be taken of the fact that most of the work would have to be done in tunnel and that accordingly, head room for the miners and other workmen would have to be provided.

Contract No. 1

A complete description of the first contract appeared in the Contract Record of March 5, 1919. The design for this contract, that down Glen Road, from Summerhill Avenue to the ravine, was arrived at after comparison of three designs, a circular shape, an egg shape and a special shape (that finally adopted), shown in figure 2.

The special shape, as adopted, was constructed of concrete of the usual 1:3:5 composition and was 4 ft 3 in. x 4 ft. 9 in. in size. This was the first sewer of this design to be built in Toronto. It was found easy to construct, and it has great strength to resist outside pressure on account of the fact that its sides are all curves.

This first contract was all accomplished in tunnel. It called for 2512.5 lin. feet of special shape concrete sewer, a ramp 12 ft. 6 in. high, eight manholes and a bell mouth, which was designed to accommodate the eastern and western sections of the next contract at Summerhill Avenue. From Rosedale Ravine to Roxborough Drive, a distance of 1700 feet, the ground is a soft, dry blue clay, not too dry, however, for easy excavation. A 10-foot shift was easily accomplished

in this, but the progress depended, to a great extent, on the progress in concreting which was, unfortunately retarded by the rigorous weather of the winter of 1917-18.

Above the ramp, the tunnel traversed a stratum of ground of a different nature. It was a very hard, dry sandy clay, through which it was impossible to make as rapid progress as had been made through the blue clay. Between this and the end of the contract, the tunnel passed through ground of a light, sandy nature, where a considerable amount of sheeting was found to be necessary. Through these two last sections, a progress of about 8 feet per day was attained.



Fig. 1.—Moore Park District, showing location of sewers for storm water flow.

The concrete was all composed of one-inch stone, screened from gravel, and on the invert was worked to a smooth finish. In places where there was a very steep grade, a 2-in. facing mixture was provided, composed of two parts of ¾-in. granite to one part of cement. All slabs and beams at manholes and chamber were composed of Class A, or 1:2:4 mix. The concrete was mixed by a Wettlauffer mixer operated by a gasoline engine.

Shafts about 25 feet deep and 8 ft. x 10 ft. in area, sheeted from top to bottom were sunk 300 ft. apart for

*Engineer of Construction and Maintenance, Sewer Section, Department of Works, Toronto.

†Resident engineer, Godson Contracting Co.



Fig. 2—A new cross-section was developed for Glen Road sewer.

the manholes and for the handling of material. An "A" frame was erected over each shaft, and two shafts were operated by one hoisting engine in tandem style.

Contract No. 2.—Eastern Portion

In the eastern portion of the second contract, as has been mentioned above, a 24-in. pipe was the type of sewer decided upon. However, a sufficient grade could not be provided for this size throughout the entire course of this portion of the work. Accordingly it was arranged to place a 3 ft. 9 in. sewer through the last 471 feet of this eastern section. This last 471 feet was designed to be built in tunnel, while the 24-inch pipe was constructed in open cut.

This 24-inch tile pipe section was the first of all the work in the second contract to be undertaken, because, seeing that its average depth was only about 7 feet, and being late in the fall, it was best to construct it first before the frost set into the ground. The excavation was all done in open cut except where

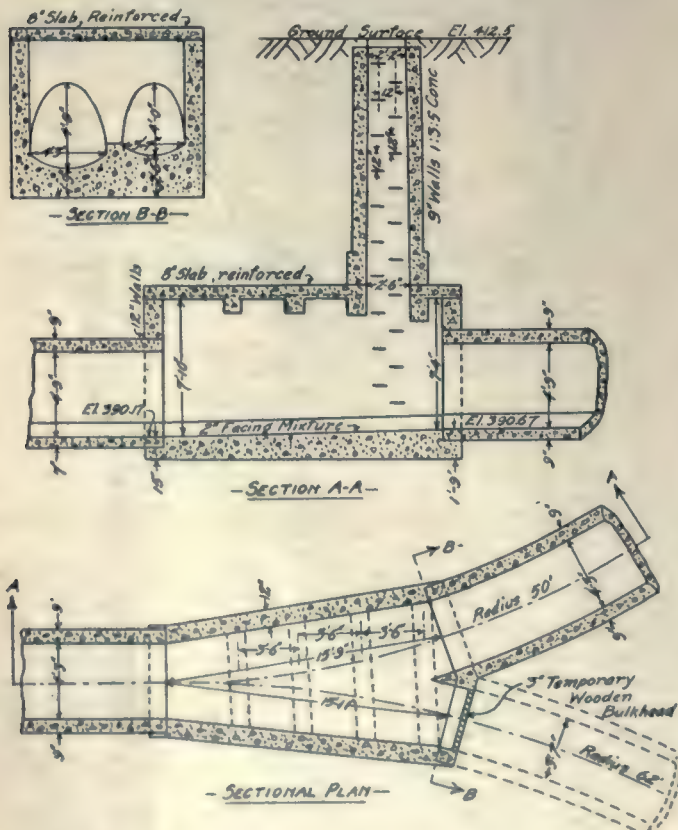


Fig. 3.—Details of junction chamber at Glen Road and Summerhill Ave.

trees, private walks or driveways occurred; under these, tunnels were made. The ground was, for the most part, a sandy clay loam; 563 lineal feet were wholly through ground of this nature, while the remaining 229 feet had an average of four feet of gray shale clay in the bottom. An average gang of 8 was employed and the progress was 18 feet in the former type of ground, and 12 ft 6 in. in the latter. This was in spite of numerous delays, caused by the slow delivery of pipe and shortage of labor. Over the pipes, to reinforce them, was placed class B, (1:3:5) concrete, 3 inches in thickness, which was allowed to set for a day before the trench was backfilled. The pipes were lowered into place in the trench by means of a hand-derrick and, in the tunnels, were levelled through with a boning rod.

The 3 ft. 9 in. section of this eastern portion was

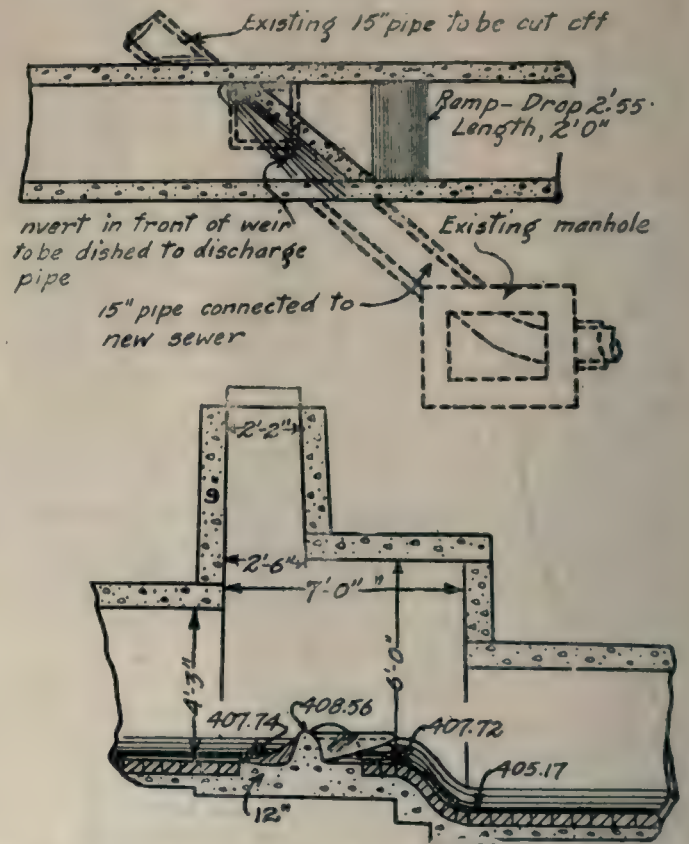


Fig. 4.—Sectional plan and elevation of manhole chamber, Sighthill and Summerhill Avenues.

circular in shape and constructed of two rings of brick. The excavation was all done in tunnel, a shaft being sunk half way between Station 0+00 and Station 4+71, and mining being carried on simultaneously in both directions through the light, sandy loam which was encountered. The progress achieved was 26 lineal feet daily, or 13 ft. in each heading. The brickwork in the invert was laid to a template graduated the size of the courses. Thus, the size of the joints was regulated, and the courses kept straight by a line stretched from each of the graduations in the template in turn to the corresponding course in the former shift. The upper half of the ring was laid on a temporary wooden arch or drum about 3 feet long. When each 3 foot length was completed and keyed, the drum was pulled down and set up again for the next 3 feet of the crown. The material used was hard red shale brick, set in 1:3 mortar.

Contract No. 2.—Western Portion

The western portion of the second contract, a 4 ft. 3 in. sewer, was designed with a ramp 4.65 feet high and a bellmouth at 0+20, and just east of Sighthill Avenue, a 2 foot ramp with a wier provided at the top to divert the dry flow into an existing sewer. From here to 20+08.7, where the western section of Moore Park was picked up, the 4 ft. 3 in. brick sewer was continued. For this contract, the contractors were required to submit prices for a concrete sewer of the same design as of the first contract and also for a 2-ring circular brick. The successful tenderer, anticipating another severe winter, when brickwork would be more economical, submitted an equal price for the two types, and it was accordingly decided to build the sewer of brick.

In this section of sewer, 1503 feet was excavated in tunnel. Shafts were sunk every 300 feet and two of them were operated by one hoist, as in the concrete section on Glen Road. The first 915 feet passed

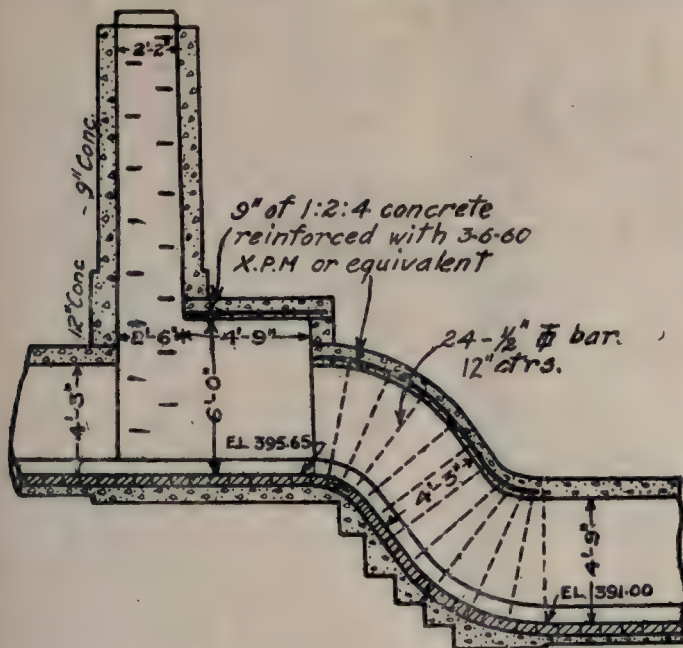


Fig. 5.—Sectional elevation of manhole at Glen Road and Summerhill Ave.

through hard blue clay above the springing line with soft red sand below. Fairly good progress was made, mining being carried on both ways from a shaft simultaneously, and the miners averaging about 10 feet per day in each heading. The next 588 ft. of the tunnel traversed a stratum of hard, blue, sandy clay, containing a small amount of water, quite a few small stones and a few boulders. Owing to the proximity of houses, and to the fact that the tunnel was only about 11 feet below the surface of the ground, dynamite could only be used occasionally and in very small quantities. For these reasons, accordingly, progress was retarded to only 4 feet per 8-hour shift. However, with four shafts in operation in this and in the other section, as much as 70 feet of the tunnel sewer was completed each day. From Station 15+03, that is, from the end of the last mentioned section to the end of the contract, a distance of 505.7 feet, the ground was a soft, yellow sand. If the winter had been a severe one, with several feet of frost in the ground, this portion could have been all tunnelled; but it so happened that there was very little frost in the ground and, as the sewer had an average of less than 8 feet of cover, the

work was done by open-cutting in bays. That is, 10 feet would be open cut and 20 feet excavated in tunnel alternately. The width of the open cut was 6 feet. In all, five shafts 8 ft x 8 ft. and 18 ft. deep were used in the tunnelled portion.

The following is the key to the letters used in the cost tables:—A, excavation; B, timbering; C, back-filling; D, moving surplus; E, forms; F, concrete; G, pipe laying; J, pumping; K, brickwork, com.; L,

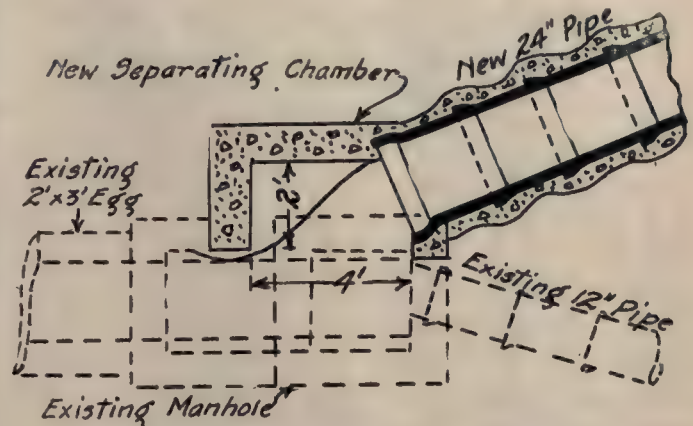


Fig. 6.—Separating manhole at end of Glen Road (C.P.R. tracks).

brickwork, vit.; M, steel reinforcement; P, rehandling material; Q, moving plant; Z, miscellaneous.

The contractor was the A. W. Godson Contracting Company, Ltd., Toronto.

TABLE I.

Cost of Laying 24 in. Pipe on Glen Road, from Station 4 + 71 to 12 + 63

	Labor Total Hours	Material Total Cub. Yards	Total Length	Unit cost in Hours per Cubic Yard	Unit cost in hours per lin.ft.
Foreman	432		792		0.54
Labor, "A"	1324½	610	"	2.16	1.67
" "C"	245	346	"	0.70	0.31
" "D"	110	264	"	0.41	0.13
" "E"	36½	71.3	"	0.51	0.04
" "F"	528	71.3	"	7.40	0.67
" "G"	436½	"	"	"	0.55
" "P"	46	"	"	"	0.06
" "Q"	29	"	"	"	0.03
" "K"	50	5.5	"	9.09	0.06
Bricklayers	27½	5.5	"	5.00	0.03
Watchman	588	"	"	"	0.74
Teams, "D"	289	264	"	1.09	0.36
" "P"	62½	"	"	"	0.08
Cement, Neat	109½	"	"	"	0.14
" Class "A"	6	"	"	"	0.007
" "B"	376½	71.3	"	5.28	0.47
" 1-3	24	5.5	"	4.36	0.03
Common Brick	2262	5.5	"	411.27	2.85
24" Pipe	383	"	"	"	0.48

Remarks.—Cut 7'; width 4'; 563 lin. feet sandy clay loam; 229 lin. feet 4' sandy clay loam and 3' gray shale clay in bottom of trench. Three inches of 1:3:5 concrete used over pipes.

TABLE II.

Cost of Mining for 4' 3" Brick Sewer (2 Rings = 9")—Shafts 3 and 4—Station 9 + 15 to 15 + 03

	Labor Total Hours	Material Total Cub. Yards	Total Length	Unit cost in Hours per Cubic Yard	Unit cost in hours per lin.ft.
Foreman	321	565.7	588	0.57	0.54
Labor, "A"	414	"	"	0.73	0.70
" "B"	193	"	"	0.34	0.32
" "C"	127	"	"	0.22	0.22
" "D"	184½	"	"	0.33	0.31
" "P"	255	"	"	0.45	0.43
" "Q"	198	"	"	0.35	0.33
" "Z"	368½	"	"	0.65	0.63
Miners	2402	"	"	4.24	4.08
Muckers	1256½	"	"	2.22	2.13
Signalman	796	"	"	1.40	1.35

Watchman	300	"	"	0.53	0.50
Engineers "N"	456½	"	"	0.80	0.77
" " "Q"	19½	"	"	0.03	0.03
" " "T"	252	"	"	0.45	0.43
" " "Z"	12	"	"	0.02	0.02
Teams "D"	685½	"	"	1.21	1.16
" " "Q"	44½	"	"	0.08	0.07

Remarks.—588' hard blue clay containing small amount of water, a few boulders and numerous small stones. Progress 4' per shift.

TABLE III.

Cost of Mining for 3' 9" Brick Sewer (2 Rings = 9") from Station 0 + 00 to 4 + 71 "East"

	Labor Total Hours	Material Total Cub. Yards	Total Length	Unit cost in Hours per Cubic Yard	Unit cost in hours per lin.ft.
Foreman	190	377.7	471	0.50	0.40
Labor "A"		"	"		
" "B"	266½	"	"	0.70	0.57
" "C"	51	"	"	0.14	0.10
" "D"	81	"	"	0.21	0.17
" "E"		"	"		
" "Q"	9	"	"	0.02	0.02
" "Z"	75	"	"	0.20	0.16
Miners	495½	"	"	1.31	1.05
Muckers	642½	"	"	1.70	1.36
Signalman	162½	"	"	0.43	0.35
Engineers "N"	199½	"	"	0.52	0.42
Teams "D"	233	"	"	0.62	0.49
Watchman	198	"	"	0.52	0.42

Remarks.—One shaft light, sandy loam, 5' 10" bore. Progress 13' per shift.

TABLE IV.

Cost of Brickwork for 3' 9" "2 Rings" Sewer from Station 0 + 00 to 4 + 71.

	Labor Total Hours	Material Total Cub. Yards	Total Length	Unit cost in Hours per Cubic Yard	Unit cost in hours per lin.ft.
Foreman "K"	207½	185	471	1.12	0.44
Bricklayers "K"	378	"	"	2.04	0.80
" Lbrs. "K"	1630	"	"	8.81	3.46
Labor "E"	24	"	"	0.13	0.05
" "P"	40	"	"	0.21	0.09
" "Z"	45	"	"	0.24	0.09
Engineers "K"	187	"	"	1.01	0.39
" "Q"	18	"	"	0.09	0.04
Teams "P"	159	"	"	0.86	0.33
Com. Brick	74978	"	"	405.3	159.18
Vitrified Brick	110	"	"	0.60	0.23
Packers Brick	4587	"	"	24.79	9.74
Cement 1-3	784	"	"	4.24	1.66
Cement "A"	7	"	"	0.04	0.01
" "B"	7	"	"	0.04	0.07

TABLE V.

Cost of Brickwork on 4' 3" Sewer (2 Rings = 9") From Station 0 + 00 to 9 + 15.

	Labor Total Hours	Material Total Cub. Yards	Total Length	Unit cost in Hours per Cubic Yard	Unit cost in hours per lin.ft.
Foreman "K"	167	393.5	915'	0.42	0.18
Bricklayers "K"	857	"	"	2.18	0.93
" Lbrs. "K"	3,304½	"	"	8.42	3.61
Labor "E"	81	"	"	0.02	0.09
" "F"	72	"	"	0.18	0.08
" "P"	117	"	"	0.30	0.13
" "Z"	14	"	"	0.04	0.02
Teams "P"	117	"	"	0.30	0.13
Com. Bricks	161,464	"	"	410.32	176.46
Vitrified Bricks	500	"	"	1.27	0.54
Pack'r Bricks	10,780	"	"	27.40	11.78
Cement 1-3	1,635	"	"	4.16	1.78
Cement 1-2-4	34	"	"	0.09	0.04
Cement 1-3-5	30	"	"	0.08	0.03
Engineers "K"	271½	"	"	0.70	0.29
" "Q"	9	"	"	0.02	0.01

TABLE VI.

Cost of Mining for 4' 3" Brick Sewer (2 Rings = 9") from Station 0 + 00 to 9 + 15.

	Labor Total Hours	Material Total Cub. Yards	Total Length	Unit cost in Hours per Cubic Yard	Unit cost in hours per lin.ft.
Foreman	265½	1124.54	915	0.24	0.29
Labor "A"	1478	"	"	1.32	1.62
" "B"	75	"	"	0.07	0.08

" "C"	94½	"	"	0.08	0.10
" "D"	108½	"	"	0.01	0.12
" "P"	155½	"	"	0.14	0.17
" "Q"	120	"	"	0.16	0.13
" "Z"	240½	"	"	0.21	0.26
Miners	1755	"	"	0.15	1.92
Muckers	1066½	"	"	0.95	1.17
Signalman	472½	"	"	0.42	0.52
Watchman	354	"	"	0.32	0.39
Engineers "N"	267½	"	"	0.24	0.29
Teams "D"	749½	"	"	0.67	0.82
Teams "Q"	18	"	"	0.02	0.02

Remarks.—0.15' hard blue clay above springing line, and soft red sand below. Progress 10' per shift.

TABLE VII.

Cut of 4' 3" Brick Sewer (2 Rings = 9") Shafts 3 and 4—Station 9 + 15 to 15 + 03

	Labor Total Hours	Material Total Cub. Yards	Total Length	Unit cost in Hours per Cubic Yard	Unit cost in hours per lin.ft.
Foreman	191½	252.8	588'	0.76	0.33
Bricklayers "K"	610½	"	"	2.41	1.04
Labor "K"	2392½	"	"	9.46	4.07
" "E"	54	"	"	0.21	0.09
" "P"	72	"	"	0.28	0.12
Engineers "K"	285½	"	"	1.13	0.48
Teams "P"	140½	"	"	0.54	0.24
" "Q"	45	"	"	0.18	0.07
Com. Bricks	106,666	"	"	42.93	181.40
Pack. Bricks	13,080	"	"	51.74	22.24
Cem. 1-3 Mix	1,086	"	"	4.30	1.85
Cement Neat	1½	"	"	0.006	0.002

TABLE VIII.

Cost of Excavating and Placing Brickwork (9") for 4' 3" Sewer in Open Cut from Station 15 + 03 to 20 + 08.5

	Labor Total Hours	Material Total Cub. Yards	Total Length	Unit cost in Hours per Cubic Yard	Unit cost in hours per lin.ft.
Foreman "A"	130½	486.3	505.5	0.27	0.26
Labor "A"	3071	"	"	6.32	6.07
" "B"	58½	"	"	0.12	0.11
" "C"	350½	"	"	0.72	0.69
" "D"	160	"	"	0.33	0.32
" "Z"	199	"	"	0.41	0.39
" "Q"	45	"	"	0.09	0.09
Teams "D"	308	"	"	0.63	0.60
Foreman "K"	126	217.4	"	0.55	0.25
Labor "F"	15	"	"	0.07	0.03
" "P"	259	"	"	1.19	0.51
Teams "P"	138½	"	"	0.64	0.27
Bricklayers	513½	"	"	2.36	1.01
" Lbrs.	1732½	"	"	7.97	3.42
Watchman "Z"	174	"	"	0.80	0.34
Com. Bricks	84150	"	"	387.00	166.46
Pack. Bricks	2613	"	"	12.02	5.17
Cement 1-3	848½	"	"	3.90	1.67
Cem. Class "A"	6	"	"	0.03	0.01
Cem. Class "B"	1	"	"	0.004	0.002

Remarks: 505 lineal feet of soft yellow sand.

The Administrative Commissioners of Montreal have advanced the salary of Mr. A. E. Doucet, the director of public works, from \$6,000 to \$8,000 per annum. The Commissioners have also advanced the salary of Mr. A. C. Read, chief engineer of the pumping station and electrical and mechanical engineer of the filtration department.

The Cut Stone Section of the Toronto Builders' Exchange have come to a settlement with their men. The journeymen stone cutters are to receive 72 cents an hour, effective from May 1 to Oct. 31, 1919, and 75 cents from Nov. 1, 1919, to April 30, 1920.

Mr. F. H. Marani, architect, has opened an office at 308 Manning Chambers, Toronto, and will be pleased to receive catalogues, etc., from building supply firms.

Drainage of Farm Lands

By H. P. Timmerman*

DRAINAGE in the east is of even greater importance than irrigation in the west, and a campaign for greater agricultural production should not overlook the possibility of very materially increasing the crops through the improved condition of land already under cultivation. The principle of under-drainage being so well understood, it perhaps is unnecessary to enter into this feature, more than to say that the labor expended in cultivation, care in the selection of seed, and money spent in fertilizing, is partially, and in some cases wholly wasted by the soggy condition of the soil.

Not only does the tile drain conserve to the earth in promoting early germination, the sun rays otherwise lost in the work of evaporation, thus utilizing this power for the early ripening of both grain and vegetables, avoiding in a wet season the rot so often destructive to potatoes and root crops, but equally in a dry season, the soil being more friable and porous, takes in and holds for the use of the plant whatever moisture there may be, or absorbs the quickest shower of rain, instead of losing it through being in a baked and hard condition. In this improvement the first cost is the only cost, and usually the enhanced value of the crop will in four or five years return not only interest but the whole amount of investment, after which all is to the good, whether the land continue to be utilized by the owner or be sold, in which case the purchase price is considerably enhanced by its increased productivity.

Unfortunately, however, the lands most neglected in this respect are in the hands of those having little ready money to get them out of the condition they are in. In many districts, too, the tile is not to be obtained as readily as it should be, owing to lack of organization for distribution and supply, for seldom does any farmer require so much as a carload at a time, and in the absence of a reasonable accessible supply of tile the matter is put off, and the business is non-existent.

Governmental Assistance

Some of the provincial governments already have encouraged farm drainage, by the loan of ditching and tile-making machines, and this policy so far as it goes is favorably commented upon by those in a position to observe its result in reclaiming land previously unprofitable to cultivate, even though adjacent to markets where farm products are in great demand. The best and most effective method, however, is where an act of the legislature admits of aid being given by municipalities to the extent of seventy-five per cent. of the cost of the improvement, not exceeding one thousand dollars in any instance. Interest is charged at the rate of five per cent., the owner of the land so improved agreeing that such interest shall be added to the municipal tax, the whole obligation to be discharged in ten or twenty annual payments.

The money necessary to carry out this programme for the encouragement of farm drainage is obtained through the sale of provincial bonds, which in turn are represented by an equal issue of municipal debentures placed in the hands of the provincial treasurer, to

whom also is remitted as interest the drainage tax, which may be imposed upon the property so improved under the terms of the provincial drainage act.

Supplying farm tile under this plan is a matter for the engineer or inspector, appointed under the act, to provide drainage plans, stake out the ground, order the quantity and size of tile, and certify to the work being properly performed, he guaranteeing according to the extent of assistance applied for each season a corresponding output on the part of local tile or brick plants, or those in the best position to supply in carloads to the nearest point of distribution. For independently conducted operations, however, and with the prospect of an active demand being created for this material, the makers of farm tile should get in touch with dealers and markets and warehouses where farm goods are received, that they may carry, in the interests of the trade, a stock of tile to be worked off in small quantities as return loading to the farm. During the next lull in operations these should be put into the ground, conforming to the general plan as to levels, direction of flow, size of tile used for mains, branches, outlets, etc., without which plan the best result is not likely to be obtained.

Building Permits for April

Activity in the building trades, as indicated by the value of building permits issued in thirty-five cities, showed an increase during April as compared with the preceding month, the total value of building permits rising from \$3,014,365 in March to \$6,457,906 in April, an increase of \$3,443,541 or 114.2 per cent. All the provinces reported gains in this comparison, especially large increases being recorded in Ontario, New Brunswick and Quebec. As compared with the corresponding month in 1918, there was an increase of 113.3 per cent., the value for April, 1918, being \$3,027,305. In this comparison no province showed a decline and the increases were particularly noteworthy in Ontario, New Brunswick and Alberta.

All the large cities, Montreal, Toronto, Winnipeg, Edmonton and Vancouver, reported increases over March, 1919, and Montreal alone recorded a decline as compared with April, 1918. Of the smaller centres, Moncton, Quebec, Brantford, Hamilton, Kingston, Regina and Calgary all showed large increases in both comparisons.

Estimated Cost of Building Work as indicated by Building Permits issued in Thirty-five Cities

City	April 1919	April 1918	April, 1919, compared with April, 1918	
			Increase (%)	Decrease (%)
Nova Scotia	\$ 418,832	\$ 328,103	* 90,729	* 27.85
Halifax	363,735	306,850	* 56,885	* 18.54
Sydney	55,100	21,253	* 33,847	* 159.26
New Brunswick	742,025	47,925	* 694,100	* 1,448.30
Moncton	742,025	12,550	* 729,475	* 5,812.55
St. John		35,375	† 35,375	.....
Quebec	839,124	825,629	* 13,495	* 1.63
Montreal-Maisonneuve	446,470	648,510	† 202,040	† 31.15
Quebec	270,125	109,044	* 161,081	* 147.72
Sherbrooke	23,500	800	* 22,700	* 2,837.50
Three Rivers	40,800	48,275	† 7,475	† 15.48
Westmount	58,229	19,000	* 39,229	* 206.49
Ontario	3,229,997	1,239,493	* 1,990,504	* 160.59
Brantford	131,205	24,830	* 106,375	* 428.41
Fort William	7,450	5,940	* 1,510	* 25.42
Guelph	53,385	26,310	* 27,075	* 102.91
Hamilton	483,310	241,200	* 242,110	* 96.00
Kingston	204,595	40,849	* 163,746	* 400.86
Kitchener	58,405	12,620	* 45,785	* 362.80
London	137,000	86,260	* 50,740	* 58.82
Ottawa	199,920	42,846	* 157,074	* 366.60
Peterborough	17,790	12,760	* 5,030	* 39.42
Port Arthur	35,271	11,216	* 24,055	* 214.47
Stratford	9,223	12,655	† 3,432	† 27.12
St. Catharines	82,282	53,990	* 28,292	* 52.40
St. Thomas	69,725	6,355	* 63,370	* 997.17
Toronto	1,620,996	570,532	* 1,050,464	* 184.12
Windsor	119,440	91,130	* 28,310	* 31.07

*Industrial Commissioner C.P.R., before Canadian National Clay Products Association.

Manitoba	249,975	174,975	* 69,000	* 39.43
Brandon	4,375	1,075	* 3,300	* 306.98
Winnipeg	239,600	173,900	* 65,700	* 37.78
Saskatchewan	343,060	154,525	* 188,535	* 122.01
Moose Jaw	44,215	30,130	* 14,085	* 46.75
Regina	187,480	20,310	* 158,170	* 539.65
Saskatoon	111,365	95,085	* 16,280	* 17.12
Alberta	407,825	72,175	* 335,650	* 466.06
Calgary	343,000	55,400	* 286,600	* 508.16
Edmonton	64,825	15,775	* 49,050	* 310.04
British Columbia	233,005	184,430	* 48,565	* 26.34
New Westminster	14,200	13,350	* 850	* 6.37
Vancouver	206,840	163,230	* 43,610	* 26.72
Victoria	12,025	7,900	* 4,125	* 52.22
Total—35 cities	\$6,457,906	\$3,027,305	* \$3,430,601	113.32

Extension to Paper Mill

Laurentide Company of Grand'Mere, P.Q., Making Additions Comprising Finishing, Storage and Shipping Buildings

By Romeo Morrisette

THE Laurentide Company, Limited, of Grand'Mere, Que., is making new additions to its plant. These consist of a new finishing room, a steel bridge and a storage and shipping building. The work has been started on the new finishing room and the company will proceed soon on the erection of the elevator shaft and the construction of the steel bridge and shipping building. The purpose of these improvements in the company's plant is to have the best facilities possible for the handling of their paper from

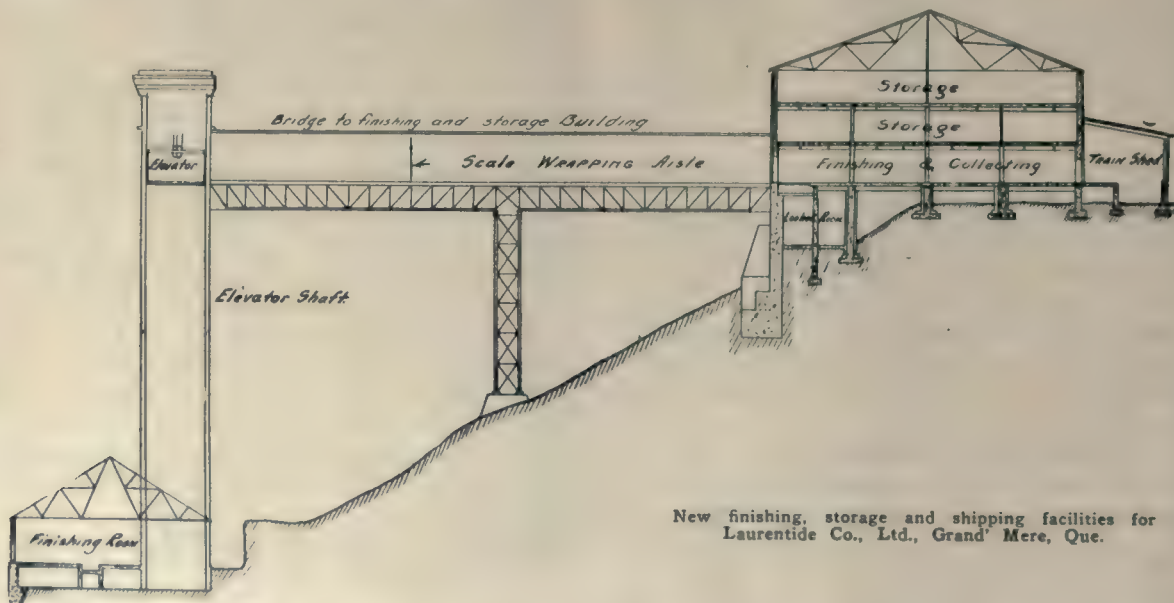
feet wide by 280 feet long. Its foundations will be of concrete, the walls of solid brick and the super-structure of steel. The flooring will be of concrete on steel I-beams. The building is so designed that the maximum trucking space will be approximately sixty feet in length. An electric hoist will be installed to handle the paper rolls to the cars.

The work has been designed by Messrs. Townsend and Perram, engineers for the company. The structural steel, which amounts to some 620 tons, is being furnished by the Eastern Canada Steel and Iron Works, Quebec. The work is done by labor under the supervision of the company's engineer.

Montreal Branch E.I.C.

A marked increase in membership and the popularity of the weekly lectures, when members read papers on technical subjects, were the features of the reports submitted at the recent annual meeting of the Montreal branch of the Engineering Institute of Canada. Mr. Walter Francis was re-elected chairman, Mr. Arthur Surveyor, vice-chairman, and Mr. Frederick B. Brown secretary-treasurer.

The executive committee were elected as follows: Two years—J. Duchastel, S. F. Rutherford and K. B. Thornton; one year—F. P. Shearwood, W. Chase Thomson and H. G. Hunter.



New finishing, storage and shipping facilities for Laurentide Co., Ltd., Grand'Mere, Que.

the paper machines to the railroad shipping point in the yard.

The first building, which is the finishing room, has concrete foundations, brick facing and steel superstructure. Inside of the building there is room for the elevator shaft. This shaft is about 120 feet high. The capacity of the elevator will be about six 90-inch paper rolls or twelve 45-inch rolls. The paper will be delivered to a steel bridge connecting the elevator to the storage and shipping building. Its length is 170 feet by 31 feet wide. The last ninety feet of the bridge will contain scales for weighing the paper rolls and will provide space for wrapping them. This section is to be called the wrapping aisle. The bridge is of the lattice braced girder type and is supported on a central column of steel resting on a concrete pier.

The new storage and shipping building will be 92

Firm of Jas. A. Wickett, Ltd., Reorganized

A reorganization has taken place in the firm of Jas. A. Wickett, Limited, Toronto, Mr. H. A. Wickett having sold out his interest in the business. Mr. Geo. E. Stocker remains president of the firm, and Mr. E. J. Smith becomes secretary-treasurer. The company has been active during the war and its organization is in excellent shape to undertake construction work of any description.

According to Mr. Walter Ramsay, of Montreal, there is a splendid opening for paint, varnish, oil and lead manufactures in Belgium, Italy, and the Balkan States, those countries having previously been dependent upon Germany and Austria for these goods.

Road Machinery to Offset High Labor Costs

Factors Governing Selection of Equipment for Construction and Maintenance of Highways—Types of Machines for Various Operations

By Arthur H. Blanchard, M.E.I.C.*

THE high wages of unskilled labor in 1917, 1918 and 1919, and the uncertain status of the labor supply of the future resulted in a thorough analysis of highway construction data to determine economical methods of using road machinery. The trend of wages of unskilled labor was ably covered in the 1919 report of the Committee on "Unskilled Labor Supply" of the American Road Builders' Association, wherein it was stated that the average rate per hour in the United States in 1912 was 19 cents; in 1913, 20 cents; in 1914, 20.5 cents; in 1915, 22.5 cents; in 1916, 26 cents; in 1917, 30 cents; and in 1918, 39 cents. In the opinion of the writer, American highway officials must face high wages for unskilled labor for several years. The basic economic law of supply and demand naturally applies to labor conditions. It is not probable that the war shortage of unskilled labor will be changed over night. It is not logical to expect that unskilled labor, which entered the Service, will rush to the pick and shovel after demobilization. Emigration records show that thousands of laborers are leaving America every month. Immigration, the usual source of supply of unskilled labor, is an unknown quantity and agitation in the United States for restricted immigration further complicates the situation. It is not surprising, therefore, that the reconstruction period finds highway officials, engineers and contractors investigating all types of labor-saving machinery.

The selection of equipment for the construction and maintenance of highways should be based upon a consideration of the following factors: (1) character of work; (2) specification requirements covering plant equipment; (3) amount of work; (4) portability of plant; (5) large and small units; (6) ease of manipulation; (7) adaptability to different classes of work; (8) funds available; (9) depreciation of plant; (10) transportation facilities. The practical necessity for the consideration of many of the above factors is self-evident.

Character of Work. In the case of contractors whose work is confined to the construction of sheet asphalt pavements and in the case of a department such as, for instance, that of Wayne County, Michigan, where the highway work consists primarily of grading operations and the construction of cement concrete pavements, the problem is materially simplified. On the other hand, where a contractor's work covers the construction of all the various types of roads and pavements used in a municipality, county or state, the selection of the several units of plant equipment should be based upon their adaptability to different classes of work. For example, where cement concrete pavements as well as concrete foundations are to be constructed, in many cases a type of mixer should be purchased which is satisfactory for the construction of pavements, the requirements for which are more specific than in the case of mixers used only on foundation work.

Specification Requirements Covering Plant Equip-

ment. In the modern practice of highway engineering, many specifications include stipulations which must be met by machines and accessories employed. As illustrations might be cited the weight of rollers, pressure limitations in distributors, grouting apparatus, and details of mixers for the manufacture of bituminous concrete.

Amount of Work, Portability of Plant, Large and Small Units. It is evident that a contractor for a department will be justified in the purchase of an ideal equipment if the work is to be extensive in character. If the work is centralized and large in amount, as in the case of sheet asphalt work, in many municipalities a large, well equipped permanent plant will prove economical. If, on the other hand, the work is large in amount but distributed over considerable area, small portable units will prove more satisfactory, as in the case of mixing plants for the manufacture of bituminous concrete to be laid on provincial highways.

Ease of Manipulation. In cases where contractors are engaged in general highway work and their organization does not include foremen who are specialists in the manipulation of various types of complicated machinery, it is of utmost importance that simplicity of machines and ease of manipulation should be given great weight in the selection of equipment. This is particularly true in connection with various types of machines used in the construction of bituminous surfaces, bituminous macadam and bituminous concrete pavements.

Adaptability to Different Classes of Work. It is well known that specifications for different classes of work, requiring the same type of machine, call for differences in detail. For grading work, specifications might require rollers weighing from 12 to 15 tons, while in the construction of wearing courses of some types of pavements a 10 to 12-ton roller is stipulated. A contractor who is handling a small amount of general highway work would, therefore, find it advantageous to purchase a 12-ton roller suitable for both classes of work mentioned above.

Funds Available. Departments and contractors are necessarily forced to consider first cost of equipment, as the funds available may not permit the installation of the most economical and efficient machines. In many cases where such conditions are encountered, it is obvious that it will not be practicable to anticipate that the work can be accomplished with the same degree of rapidity and at the same cost as if more efficient machinery constituted the plant equipment.

Depreciation of Plant Equipment. Depreciation charges on plant equipment should be given careful consideration prior to the purchase of machines and accessories as well as in the consideration of the cost of highway work.

Transportation Facilities. Facilities for the transportation of machinery and materials affect the efficiency of the several units of plant equipment.

Brief consideration will be given to the plant equipment suitable for grading, quarrying, construction of

*Consulting Engineer, New York, before Canadian Good Roads Congress.

the several types of roads and pavements, and snow removal. It is also evident that normal conditions usually will be assumed as the basis for suggestion of plant equipment for the various items of highway work enumerated.

Transportation Equipment. Motor trucks and wagons usually will be found a necessary part of the equipment for all classes of highway work. Tractors and trailers are proving of particular value on long haul work where loading and unloading apparatus require motor trucks to remain idle during several hours a day. Industrial railroads have proven efficient equipment on highway work where a large tonnage is to be handled quickly on long hauls.

Grading. Grading operations vary from the scarifying of an old road surface, preparatory to the construction of a new wearing course, to heavy cut and fill work requiring the moving of thousands of cubic yards of material. It is apparent that only extreme conditions can be mentioned in this discussion as the economics of the utilization of various classes of machines on average grading would necessitate a com-



A mechanical broken stone loader.

prehensive discussion. For the lightest class of grading mentioned, scarifiers drawn by rollers have proved more economical and efficient than the use of picks in roller wheels or any one of the several types of plows drawn by rollers or tractors. For the heaviest class of grading work, in many instances steam shovels loading into wagons will be found economical. In connection with all grading work except light scarifying, one or more of the following types of machines should form a part of the plant equipment for grading: road drags, grading and rooter plows, drag, buck and wheel scrapers, elevating graders, and rollers. It should be noted that the utilization of the elevating grader has not been fully developed by many contractors.

There are on the market many types of steam and gasoline traction engines suitable for hauling grading machinery. For many classes of grading work, their use is more economical than the employment of horses and mules. Essential features which should be based by a contractor for grading work are as follows: (1) sufficient power for hauling the several types of grading machines under the variety of conditions on which

it is expected to be used; (2) adequate mechanical strength; (3) simple mechanism enabling it to be easily steered, controlled and otherwise operated; (4) driving wheels of large diameter and of such width as to enable the tractor to operate efficiently on soft ground.

Quarrying. Plant equipment for quarrying depends primarily upon the kind of rock, the required output per day, and the length of time during which the quarry will be worked. Drills and blasting devices are a necessary part of all equipment for rock work. Contractors or departments working the quarry to supply material for a specific highway would use the ordinary portable crushing and screening plant consisting of boiler, engine, jaw crusher, elevator, screen and bins. Small quarries, more or less continuously operated, are generally equipped with the above plant except that in many cases the gyratory crusher proves more economical. Passing to the largest quarries, modern equipment for the economical manufacture of broken stone should consist of steam shovels for removing the rock masses from the quarry face to steel cars. In such quarries the pieces of rock transported to the crusher may vary in size up to masses weighing 7 or 8 tons. The rock should be first crushed in a mammoth jaw crusher from which the rock should be passed through a series of gyratory crushers, jaw crushers and rolling mills and thence to elevators, screens and bins. In some plants of this type washing devices are a necessary part of the equipment in order to produce stone chips free from dust.

Earth Roads. In the construction of earth roads on a large scale, the following equipment has been found to be economically efficient: elevating grader drawn by horses or by a tractor, scrapers, disc and straight-tooth harrows, road drags, rollers and watering carts. The combinations of the machines mentioned which will be used will depend upon the amount of work, character of the soil and the cross section to which the road is to be built.

Gravel Roads. Spike-tooth harrows, scrapers, road drags, rollers and watering carts constitute the equipment for the construction of gravel roads. Many engineers and contractors have found grooved rollers more satisfactory for this class than smooth-faced rollers.

Broken Stone Roads. The average equipment consists of rollers and watering carts. For many types of construction and kinds of rocks, rolling for long periods with 10 or 12-ton rollers has secured a better compaction and economical bond than in cases where 15 and 18-ton rollers have been used for short periods. Some contractors have found automatic screening spreaders a valuable addition to the plant equipment.

Bituminous Surfaces. The equipment required for the construction of bituminous surfaces depends upon the amount and character of the work and the rapidity with which it must be accomplished. For example, the construction of a bituminous surface on a broken stone road will require an equipment of rotary brushes or coarse fibre broom, bass fibre brooms, in some cases batteries of heating kettles, a distributor to meet specifications and adaptable for the distribution of the kind of bituminous material under conditions stipulated in the specifications, pouring cans, squeegees, and, in some cases, 5 to 10-ton rollers and hand-drawn or horse-drawn automatic stone chip distributors.

Bituminous Macadam Pavements. The equipment will depend primarily upon the specifications and the kind of bituminous material employed. The usual

equipment consists of batteries of heating kettles, a distributor, pouring cans, and a roller. The specifications covering certain features of the distributor may be specific, as in the case of the 1918 specifications adopted by the American Society of Municipal Improvements herewith quoted:

"The pressure distributor employed shall be so designed and operated as to distribute the bituminous materials specified uniformly under a pressure of not



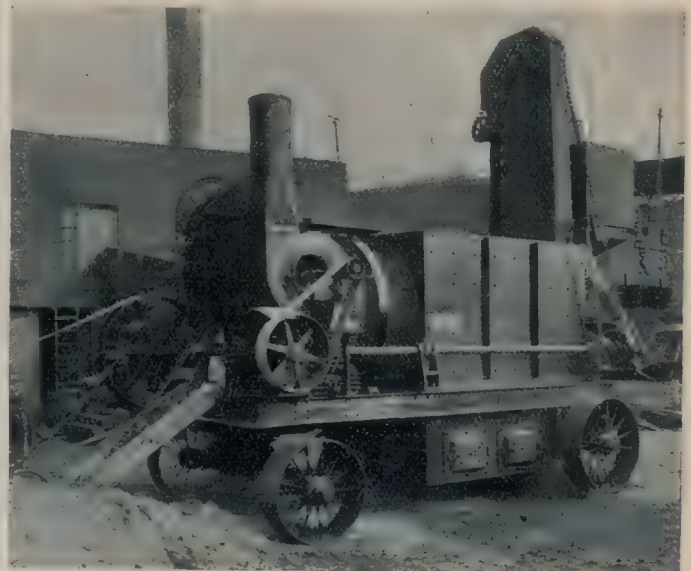
Pressure distributor.

less than twenty (20) pounds nor more than seventy-five (75) pounds per square inch in the amount and between the limits of temperature specified. It shall be supplied with an accurate stationary thermometer in the tank containing the bituminous material and with an accurate pressure gauge so located as to be easily observed by the engineer while walking beside the distributor. It shall be so operated that, at the termination of each run, the bituminous material will be at once shut off. It shall be so designed that the normal width of application shall be not less than six (6) feet and so that it will be possible on either side of the machine to apply widths of not more than two (2) feet. The distributor shall be provided with wheels having tires each of which shall not be less than eighteen (18) inches in width, the allowed maximum pressure per square inch of tire being dependent upon the following relationship between the aforesaid pressure and the diameter of the wheel. For a two (2) foot diameter wheel, two hundred and fifty (250) pounds shall be the maximum pressure per linear inch of width of tire per wheel, an additional pressure of twenty (20) pounds per inch being allowed for each additional three (3) inches in diameter."

Bituminous Concrete Pavements. The type of pavement, amount of work, the specifications and the kind of bituminous material employed materially affect the selection of the plant equipment for this class of work. Batteries of heating kettles and a roller are required for the construction of all types of bituminous concretes. Although the practice of contractors has varied to a considerable extent with reference to the weight and type of roller, many now favor the 10 to 12-ton roller for all classes with the exception of Topeka bituminous concrete. Plants of many types have been successfully employed in the manufacture of bituminous concretes. Naturally the most economi-

cal and efficient work has been accomplished by a plant especially adapted for mixing the type of aggregate used. Generally, on highway work outside of urban districts, the portable plant proves most satisfactory. Dependent upon the plant accessories, the aggregate is measured by volume or weight before being dried or by weight after drying, the latter being preferable. The aggregate is usually dumped into bucket elevators, which discharge into rotary driers. In the best types of plants, the heated aggregate is then raised by bucket elevators and discharged into a small storage bin. As desired, the heated aggregate is drawn from the storage bin and allowed to fall directly into the pug mill mixer or, preferably, first into a weighing box. The bituminous cement is weighed in scales on the mixing platform and then dumped into the mixer. After thorough mixing, the bituminous concrete is usually discharged into a wagon or truck, which the plant arrangement permits to be placed directly beneath the mixer. For pavements of the type of Bitulithic, a rotary screen, several bins and a special weighing disc are necessary adjuncts to the plant. For those types of bituminous concrete in connection with which seal coats are employed, the equipment will necessarily be increased by the addition of hand-drawn distributors, pouring cans, squeegees, and, in many cases, hand-drawn automatic stone chip distributors.

Sheet Asphalt Pavements. The plant equipment necessarily depends upon the amount and location of the work and the specifications. A tandem roller constitutes a part of the equipment for all sheet asphalt work. The mixing plants are of three types, portable, semi-portable, and permanent. A complete plant includes a cold sand elevator, a drier, a hot sand elevator, a hot sand storage bin with screen, an asphalt elevator, a flux tank, melting tank, draw-off tank, a sand



Bituminous concrete mixing plant.

measuring box, a dust elevator, bin and measuring box, an asphalt cement bucket and a pug mill mixer.

Cement Concrete Pavements. Variations in economical equipment depend primarily upon the specifications. A beam and bucket cement concrete mixer, forms, screens, bridges, belts, long handled light rollers, watering carts, pumps and hose usually constitute the equipment for the construction of cement concrete pavements constructed by the mixing method.

The essential features of a plant are covered by the following excerpts from a report of a committee of the National Conference on Concrete Road Building: "The concrete mixer should be of the batch type provided with an automatic water tank, traction drive and power loader. Mixers having a boom and bottom-dump bucket of sufficient size to convey one complete batch for placing the mixed concrete are preferred. Where necessary to keep from cutting into the sub-grade and to facilitate moving, the wheels of the mixer should be run on suitable planking. The mixer should be provided with a suitable automatic water tank which can be quickly filled and emptied, so that when once determined, the required amount of water can be added to each batch of concrete. The power loader or skip should be of sufficient size to hold all the materials required for the batch.

Wood Block Pavements. For the building of wood block pavements, the equipment should include the necessary apparatus for the construction of the mortar cushion, or a template and hand roller when a sand cushion is employed, a tandem roller weighing from 3 to 5 tons and the necessary distributing apparatus for

the application of fillers and the construction of expansion joints.

Brick Pavements. The equipment should include a wood template and hand roller for the construction of the sand cushion, double metal template for constructing a mortar bed on a green concrete foundation, a tandem roller weighing from 3 to 5 tons, brushes, cement grout boxes or a small mixer if a cement grout filler is employed, or conical pouring cans if bituminous fillers are used for the construction of transverse or longitudinal joints.

Stone Block Pavements. The equipment includes, in some cases, templates and hand rollers for the construction of the sand cushion, tampers and the necessary apparatus for filling the joints.

Snow Removal. Equipment for snow removal is affected by the amount of snow in a storm, the yardage and location of the roads to be cleared. For highways outside of urban districts, road scrapers and horse-drawn and motor plows have been found economical and efficient. In the case of many roads, compaction of the snow being principally required, snow rollers constitute the equipment.

Treatment of Gravel Roads with Refined Tar

Disintegration Reduced by Surface Applications That Increase Traffic Capacity of Road and Add to its Resistance

By Philip P. Sharples*

THE word "gravel" means quite different road materials in different parts of the country. As it is used in this paper, it refers to the glacial gravels common in Northern New England and in the Eastern or Maritime Provinces. These materials contain a minimum amount of clay as a binding material. Clay is sometimes entirely lacking and the binding effect is produced by the presence of iron-bearing materials in the sand.

Gravel roads thoroughly well built upon accepted principles are to-day taking care of considerable traffic on the state highway systems of the states of New Hampshire, Vermont and Maine. As these states are contiguous to the provinces, their problems are not unlike those of the provinces.

Gravel Roads Will Lead in Mileage

Owing to their low cost, gravel roads must continue, for many years to come, to constitute the greater part of the mileage. For every mile of more permanent types of construction built, there must necessarily be a dozen or more miles of gravel roads constructed. These gravel roads should be built with great care in reference to drainage and to location. They cannot permanently give satisfaction unless they are well located and well built.

The methods of maintenance of gravel roads have been well worked out. They should be carefully reshaped in the springtime, and should be kept up by using the road drag after every rainy season throughout the year. This maintenance is best done by the patrol method. Men, resident along the road, are each given 5 to 10 miles of roadway to look after and are held responsible for keeping the road in good condition at all times. These men should be selected for

their intelligence and trustworthiness, and should be responsible directly to the division engineer or other technical man in charge of the road work.

Over 200 Vehicles a Day Cause Disintegration

Gravel roads built and maintained properly in this way are capable of standing approximately 200 vehicles per day without great deterioration and without undue expense in upkeep. If, however, the traffic exceeds this amount, the dust nuisance becomes very grave and the roads disintegrate too badly under the traffic to be kept easily in shape by dragging. Experiments have been made with bituminous materials in surfacing these roads.

A thorough study of each local gravel is necessary in order to determine the best method of treatment and the best bituminous material to use. In the State of Maine, refined coal tar of such consistency that it may be used cold has given very successful results, and methods of maintaining the surfaces through a period of years have been worked out. It is useless to apply surface treatments of any kind of bituminous material on gravel unless continuous maintenance is instituted at the same time. All gravels run unevenly. Soft spots are sure to develop beneath the surface treatments, and unless the breaks in the surface are repaired immediately, the surface soon disintegrates generally, and the road is worse than if no treatment had been applied.

Forms a Crust Over the Surface

The refined tars used for this purpose actually penetrate into the gravel forming over the surface a crust which has considerable strength. It is important therefore, in order to secure good results, that these treatments are made only over gravel roads that are able to sustain surface crust without allowing too

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much movement under traffic. Gravel roads should not be treated immediately after construction, but should be allowed to settle and harden gradually at least one winter. In the spring the road is shaped up and then dragged until it does finally harden for the season. A refined tar is then applied cold. The best results are obtained by putting it on with a pressure sprayer, either horse-drawn or power-driven. One-fifth of a gallon (Imperial) is sprayed on to the road and is allowed to soak in without covering it. A second coat of one-fifth of a gallon is then applied after an interval of from 2 to 24 hours. If this second coat is not wholly absorbed by the road, a light coating of sand or gravel may be spread over the surface. This, however, should be only in such quantities as to absorb the excess of refined tar. The road will gradually harden up and after a week or ten days of traffic will be smooth and firm, and resemble in every way a macadam road treated in the same way.

Keep Surface Intact

The surface should be maintained through the season by patching with the same cold refined tar when-



This gravel road, receiving refined tar applications for five years, takes heavy main line traffic up to 8,000 vehicles a day.

ever a break occurs; in order to keep the surface intact. Treatments put on in this way last generally well into the winter. Their endurance through the period when the frost is coming out of the ground depends much on the drainage of the road, on the exact character of the gravel used, and on the season. After a winter of very heavy snow, followed by a short spring, these surfaces may come through the spring without breaking up and be ready for retreatment without requiring any work upon the surfaces. In other cases, the surface may break entirely and the road be in no better shape during the spring than any other gravel road. In this case, it is necessary to re-shape the surface and then to drag it back into shape until it has hardened up in the same way that the road was prepared when it was originally treated. A refined tar is then applied as in the first place, although it is found that usually a much less quantity is required than in the original treatment. In cases

this may be as little as one-fifth of a gallon (Imperial) for the retreatment.

Improvement on the Original

On some sections of the Maine State Highway between Kittery and Portland, the roadway has never broken up during the spring, so that the treatments have accumulated on the surface. This road was, however, an inheritance and was not of very good construction, so that the surface generally has heaved considerably by the frost and in the course of time became somewhat out of shape. It was therefore necessary, following five years of treatment, to break up this surface in order to smooth it out. This was accomplished by a scarifier on a 12-ton steam road-roller. The tar-bound pieces of gravel were further broken up with heavy harrows with steel spikes. After the road was thoroughly broken up, it was re-shaped and then rolled back into condition with the road roller. A new treatment of cold refined tar was applied, as in the original treatment, and the work proved to be even better than the original treatment. The glutination of the gravel with the tar seems to produce a material that somewhat resembles a tarred stone surface that compacts easily with the fresh coating of tar to form a surface very like a macadam surface. This is more permanent than the original surface so that this surface keeps in shape much better than the original treated surface.

The experience gained in this work has been very encouraging and opens the way to preparing gravel surfaces to take a very much heavier traffic than they have been able hitherto to endure. With these treatments, the state highway between Kittery and Portland has carried as high as 2,000 to 3,000 vehicles per day during the summer months, with not too high upkeep costs. The same highway has sections of tar-bound macadam and of concrete with which these gravel surfaces compare very favorably during the summer months.

Road Policy for Island of Montreal

Several members of the Quebec Provincial Legislature, representing constituencies on the Island of Montreal, conferred in Montreal last week on the proposal of Lieut.-Col. George R. Hooper, that an advisory commission be formed with a view to formulating and carrying out a definite road policy for the island. It was pointed out that the present system of location, construction and maintenance deprives the public of much of the value of the good roads in existence, or to be laid, as many fine sections of highway are interspersed with bad stretches. A comprehensive plan of linking up the existing roads, and a standardized policy of construction and maintenance, could only be carried into effect by some such body as is proposed. The conference will be resumed after the provincial elections.

At the forthcoming Canadian Good Roads' Congress, in Quebec City, a proposal will be brought up for the formation of highway commissions for large districts embracing many municipalities, such as one for the whole island of Montreal, thus ensuring uniformity of construction on main highways and also assisting the various municipalities in their improvement programmes by making available expert advice.

Concrete Roads, Bridges and Culverts

Mr. H. E. Breed Before Canadian Good Roads Congress Outlines
Features of Importance to be Observed When Using Concrete

THE trenchant title of the paper assigned me assures concrete its rightful place in the family of good roads so as to make superfluous any further introduction from me concerning its value.

Concrete pavement is composed of cement and fine and coarse aggregate, with the admixture of water.

Fine aggregate is sand, crushed slag or rock, consisting of hard, durable particles smaller than $\frac{1}{4}$ in. in size, free from organic impurities, carrying not over 5 per cent. of silt or loam, and of such gradation as will give equal or greater compressive strength than the standard Ottawa sand, when tested in like manner, using the same cement.

Coarse aggregate is crushed rock or pebbles, consisting of tough, hard particles free from dust and of such size as will pass a 3-in. circular ring and be retained in a $\frac{3}{8}$ in. circular ring.

The success or failure of the pavement depends on quality, sizing and proportioning of the materials and the placing and curing of the concrete.

First in importance are the materials used; they determine the quality of the pavement. The fine aggregate should be tested for:

1. Organic Impurities.
2. Gradation (sieve analysis).
3. Mortar strength.
4. Volume of silt or loam.

Field Tests

I shall give only the field tests, as these are the most useful and can be readily made by the inspector to determine that the material being used measures up to that approved by the laboratory tests.

1. Organic impurities are detected as follows: "Fill a 12 oz. graduated prescription bottle to the $4\frac{1}{2}$ oz. mark with the sand to be tested. Add a three per cent. solution of sodium hydroxide (NaOH) until the volume of the sand and solution, after shaking, amounts to 7 oz. Shake thoroughly and let stand over night. Observe the color of the clear supernatant liquid." If it is colorless, or has a bright yellow color, any organic impurities contained are harmless. If it shows a darker colored solution, the sand should be rejected and accepted only after full Laboratory test, a description of which can be found in Part I of the 1917 Proceedings of the American Society for Testing Materials, pages 327—333.

2. Gradation tests for sand (sieve analysis). Field testers are made which have the $\frac{1}{4}$ -in., the 20 and the 50 sieves. By the use of these it can be determined whether the material comes within the limits of the specification.

3. Mortar strength test must be made in the laboratory, on account of the necessity of a testing machine to determine the compressive strength. However, a test for set can be made in the field by mixing the sand with cement and forming a pat with thin edges. By breaking the edges after 24 to 48 hours, the engineer can determine how the material sets.

4. Volume of silt or loam is determined by adding an excess of water to a given quantity of sand in a

glass graduate. The whole is well agitated and allowed to stand until the loam and silt have settled on top; when their percentage may be measured.

The coarse aggregate cannot be tested in the field. Field determination of these materials can be made only for voids. Visual inspection should, of course, detect soft material and dirty aggregates. Such inspection should be made constantly, to know that the material is running uniform and of quality equal to the original sample. When we realize that nature never has two deposits alike, the importance of these tests in securing good work will be readily appreciated.

Indicates Difference Between Poor and Good Stone

For laboratory test of coarse aggregates, the most valuable is the Deval abrasion test. It is in general use and has been standardized. How accurate it is in determining the suitability of coarse aggregate for concrete remains to be seen. Certain it is, however, that this test indicates the difference between poor and good stone; and taken in conjunction with the impact test, which I will describe later, it is the best means we yet have of determining the suitability of stone for concrete roads.

The tests for pebbles, by some called gravel, with the Deval machine have been unsatisfactory, because certain pebbles much inferior in service to trap and syenite rock, show less loss when tested than do these standard materials. In 1915, in our New York State Highway Department Laboratory, we modified the Deval stone abrasion machine, by substituting a slotted cylinder for the closed cylinder. The slots allow the fines to escape, so that there is no protective cushion of dust to keep the pebbles from wear. For four years we have found that this machine has given slag and pebbles a truer rating in accordance with the service test, though often at variance with the showing of the standard cylinder.

After testing the aggregates, we make tests of the concrete they compose, for two purposes: first, to determine its wear; second, to determine its strength.

Wear Resistance of Aggregates

By far the most valuable test to determine the wear resisting values of various aggregates used in concrete roads, is a machine which generates impact stresses, closely paralleling those set up by traffic. This machine is described in the Engineering News Record of May 2, 1918, by H. S. Mattimore, engineer in charge of physical testing, New York State Commission of Highways. In general the machine consists of an arm which is raised by a cam and falls freely, striking the concrete cube. At the head of the arm are placed nine hitting points, armored with non-slip horse calks, each point and its shaft being held in place by a spring giving $\frac{1}{2}$ -inch play to compensate for any irregularity or unequal wear during test in the surface of the sample. The effective weight of the head is 29 lbs., and the blows are delivered at the rate of 100 per minute. The sample used is a 6-inch cube or cylinder placed upon a table which is revolved by a dog attachment, so that the blows of the calks strike in 9

concentric circles $\frac{1}{4}$ -inch apart. To date, several hundred tests have been run with this machine.

The results indicate that generally the average loss increases as the mortar strength of the sand decreases. An average loss of each test shows that there is greater strength in the 1:1½:3 mix than in the 1:2:4 mix. It is interesting to note that syenite with the French coefficient of 12.5 shows approximately an equal loss under this test to Buffalo lime stone with a French coefficient of 7.9. On the basis of the Deval test, the lime stone is inferior for road purposes to the syenite, but service conditions indicate that the Buffalo lime stone and many other lime stones with a French coefficient of 7 and better, are very satisfactory in service. In general six conclusions seem justifiable:

1. Crushed stone concrete resists impact better than gravel concrete.
2. Large-sized material is more durable than the small sizes.
3. Toughness is a very important factor in aggregate that is subjected to impact.
4. The fine and coarse aggregate must both be good if we are to get the most from the pavement.
5. Coarse grained sand mortar resists impact better than a mortar made with finer grained sand.
6. No relation has as yet been observed between compressive strength and resistance to impact.

Determination of Strength.

In the test to indicate strength concrete from a batch is made up on the road into six-inch cubes, or 6 by 12-inch cylinders from every 500 cu. yds. or less of material. They are cured for 21 days in moist sand and then shipped into the laboratory and tested at 28 days. The following is a record of four years' work done under my direction:

Years	Mix	Coarse Aggregate	No. of Cubes	Average Compression per Square inch
1915-16	1:1 1/2:3	Stone	1684	3950
1917-18	"	Gravel	221	2950

You will note that a total of 1905 tests were made and that with the exception of the gravel, they are well over 3000 lbs. per square inch. When any individual test shows below 3000 lbs., we immediately made a thorough investigation to determine the cause. While this would occur too late to correct the given piece of work, it had a good moral effect on the contractor; and wholesome rivalry was inspired among the engineers to have a high test value for their work. The figures given above represent actual tests from the laying of something over 400 miles of 16 ft. concrete pavements of 6 inches average thickness.

Methods of Application

Next in time, but of equal importance to the choice of materials, is the method of application. Upon this depends the strength of the pavement.

First. Proportioning.

The mix should be proportioned in such a manner as to give the greatest density. For the general run of materials and the strength necessary, the 1-1 1/2-3 mix most nearly meets all requirements. Varying slightly, the fine and coarse aggregates as indicated by the field tests for voids, so that greatest density is obtained. The coarse aggregate should consist of well-graded particles from $\frac{3}{8}$ to 3 in. in size.

Second. Mixing should be thorough and of at least one minute duration; however, many specifications require a minute and a half. Whatever the requirement, there is just one sure way to get the full

time called for, that is by use of the batch meter. It eliminates all argument with the inspector. It is fairer to the contractor, for it puts them all on the same basis. The water used must be clean and free from oil, acid, alkali, or organic matter. An excess of water impairs the strength of the concrete. Only enough should be used to make the concrete workable. Professor Abrams says that his experiments show that one pint more water than necessary to produce a plastic concrete, reduces the strength to the same extent in a one bag batch, as though it had been robbed of two or three pounds of cement. Bulletin No. I, entitled, "Design of Concrete Mixtures," by Duff A. Abrams, Lewis Institute, Chicago.

Third. Placing and Finishing.

There are two methods of finishing concrete after it has been placed upon the subgrade. One is by the use of a machine finisher; the other, which is still more generally used, by hand. Machine type of finishing is proving more and more satisfactory. It gives a uniform, smooth finished result, lessens the amount of labor behind the mixer—a decided advantage in the present labor shortage—and by permitting a stiffer mix insures a stronger concrete. By hand, the finishing is done in various ways. The one that gives the best results is by use of a steel shod strike-board to level and tamp the concrete. This should be followed by a light roller to take off the excess water and compact the concrete. In some cases this is all the finishing that is done. Greater smoothness may be secured, however, through the use of two belts which are drawn backward and forward across the pavement with a slightly diagonal motion in moving ahead.

Fourth. Curing.

On this depends the final set and durability of the pavement, soon after the use of the final belt, the surface should be protected by an awning of canvas to prevent rapid evaporation. There are two methods of curing, that of the earth covering with subsequent sprinklings to keep the earth moist; and that of ponding. Both of these methods can be put in operation as soon as the concrete has hardened sufficiently to stand the earth cover or the dams for the pond. With the earth cover at least two inches of earth should be put upon the pavement; for the ponding, a depth of two inches of water should be carried. If the temperature is running below 50 degrees Fahrenheit, the covering can be omitted and the concrete sprinkled two or three times a day. Traffic should be kept off the pavement for at least fourteen days, though the cover can be removed after ten days of ordinary weather. During cold weather, opening to traffic should be still further deferred unless calcium chloride is used to accelerate the set of the concrete.

Concrete Pipe Culvert Worth Consideration

All that I have said so far of concrete for roads applies equally to concrete for bridges and culverts with the exception of such obvious details of curing and finishing as must be familiar to everyone. Worthy of special emphasis here, however, is the concrete pipe culvert because many road builders do not yet seem fully aware of its value. The laying of culverts is almost the first piece of work to be done on a job. To have to wait for the arrival of sand and stone to mix concrete often means loss of time and labor that would be conserved if the contractor had his concrete pipe culvert delivered direct from the manufacturer all ready to put in. Then the rest of the work could proceed independently and to greater advantage. The

head walls of the culvert can, of course, be built on at any time.

All that might stand as part of a primer on concrete road building. It is trite. I have ventured to bore you with the repetition of it only because every failure I have ever seen in concrete pavement has been directly traceable to some neglect of these first principles.

Now, taking for granted the skill and care essential to the success of our pavement, let us jump from the primer to the last chapter of a treatise on engineering. Consider very briefly economy of construction.

There are three general methods of building concrete roads:

1. The delivery of the materials on the sub-grade.
2. The delivery of batches direct to the mixer.
3. The manufacture of materials at a central mixing plant.

The first method (materials on the sub-grade) has the advantage, as a rule, of lower plant charges, but it requires more labor and involves a loss of from five to ten per cent. of the materials used, plus the necessity of re-shaping the sub-grade. The second method (delivery of batches direct to the mixer) has the advantage of saving the loss of materials on the sub-grade and eliminating the extra grading cost; it lessens the number of laborers needed and insures the delivery of materials, when industrial track is used, at times of soft sub-grade and inclement weather. The third method (the central mixing plant) is most economical of all. It saves time and labor through the stationary mixer and the once-made sub-grade. Its chief disadvantage, the segregation of materials in transit, may be obviated by the use of a dry mix and a finishing machine.

If the materials are placed upon the subgrade, great care should be taken that the piles or winrows of material are of such size and so placed as to require little handling to get them to the mixer. I have known poor placing to increase the manipulation cost one-third.

Where local stone is being manufactured, screenings can be used in some cases for the fine aggregate. Thus we save what generally is a waste product. However, before permitting their use, thorough tests should be made of their fitness. I have had tests made of commercial stone screenings showing all the way from 95 to 240 per cent. of the compression strength of Ottawa sand.

Use of Local Materials

A thorough examination of the site of the work and its surrounding territory will often disclose good, available local materials. One may fall here between two evils—a too cursory or inexperienced examiner who finds nothing where there is much; or a too zealous discoverer who ardently insists that what he finds is good, whether or no. The people for this work are those with sound training in geology and mineralogy. They will save the state many thousands of dollars that might be lost either through the consideration of poor materials or through needless transportation charges.

In another way hitherto neglected can the State save large sums in building its concrete roads. We all know that by the use of well-graded aggregates in making concrete the necessary amount of cement, its most costly factor, is diminished. In other words, the finer stones fill up the interstices that would otherwise absorb cement and sand. Or, using the same amount

of cement and sand, and the well-graded stone, you can get an increase over the ungraded stone of from five to ten per cent. in bulk. Shrewd contractors have been quick to take advantage of this, in spite of the fact that some states, like New York, have written their specifications for a graded aggregate. I believe the states would save large sums of money and secure much better work by buying all the materials for the concrete used in road work.

But that is matter for another story, which would detain us now beyond limits. I will only say with a careful attention to adjectives, that built with due care for first principles and close observance of practical economies, the concrete road will yield generally satisfactory results at comparatively low cost.

Good Roads and Agriculture

Roads Provide Vital Link Between Farm and Market—Greater Production Assured by Good Highways

By Geo. S. Henry*

THE roads of the country provide the vital link between farm and market, and are more closely related to agriculture than to any other of our national industries. The country has arrived at a point in its development when much depends upon the work of the farmer. The war has left us with annual interest charges of approximately \$125,000,000. To meet these charges, together with the sinking fund, our national resources must be developed, while strictest economy must be practised.

It is evident that the railway machinery created to take care of the production of the country is sufficient to deal with at least twice, if not three times, the existing output, and it is obvious that the burden of interest upon the immense amount of capital supplied will be a heavy one until the productive power of the country is greatly increased. I am convinced that every possible effort will be made by all concerned—the Canadian government, the provincial government, the municipalities, the great railway companies, bankers, traders and others—to increase rapidly the agricultural output of the country upon which the welfare of the Canadian people, both individually and collectively, absolutely depends, and that the effect of their concerted effort will be so great that the country will carry with safety a burden which might otherwise overtax its strength. It is, however, of the greatest possible importance that the work of directly increasing the productive power of the country by placing a larger proportion of the population upon the land should be carried out with the least possible delay.

Agriculture the Largest Wealth Producer

In other words, in the years which are coming upon us, the farmer and the farm must occupy an even more important place in the economy of the nation than ever before, for while our forests, our mines, our fisheries, and our manufacturers, are all important, agriculture has and will play in the future by far the largest part in the wealth production of Canada. Speaking more particularly of agriculture in the province of Ontario (and what is said of this province is true proportionately to a greater extent of the other provinces of the Dominion), the strictly rural population of the

*Minister of Agriculture, before Canadian Good Roads Congress.

settled portions of the province stood in 1911 at 1,024,000 as against 1,271,000 in the urban municipalities, so that the farmers constitute by far the most numerous single element in the country. In the aggregate they have the largest capital investment in the province; the last census shows the following comparison: capital investment in agriculture (Ontario only) \$1,283,000,000; capital investment in manufactures and industries (Dominion of Canada) \$1,247,500,000; so that agriculture in Ontario exceeds the investment in manufactures and industries in the Dominion by \$35,500,000. These figures have changed materially since the war period, and while our manufacturing plants have greatly increased in value, the value of the agricultural products of the province has grown from \$175,000,000 in 1911 to \$335,000,000 in 1918 in field crops. The total including animals and their products amounted to \$450,000,000 in 1918, and it has been demonstrated that the application to all the farms of the province of the methods employed on the best ten per cent. of them would double the value of its agricultural production.

Good Roads Aid in Better Production

How great would be the prosperity of Ontario if her agricultural production rose to \$900,000,000. In no other department of the life of the community is any such increase of wealth even remotely possible within a reasonable period. General conditions are necessary to such a result, and they range from willingness on the part of the farmer to adopt the methods actually in use by some of their number to the provision by the people of the equipment which is necessary. Good roads are part of the equipment supplied to the individual farmer by the community. The man whose farm is separated from its market by several miles of difficult roadway wastes part of his time, his energy and his capital on unnecessary effort in transportation; he is driven into the less productive kinds of farming, and he loses part of the proper returns, even from his unproductive type of farming. Good roads will not of themselves increase production and enhance values, but they give the farmer a chance to do these things, and they are an indispensable preliminary to the process of getting more from the land.

The suggestion that the social development of the rural section is necessary for the purpose of rendering the farm a more pleasant place to live, and thus checking a further movement from farm to city, is important and necessary, and good roads will undoubtedly play a big part in eliminating the isolation of the farm. It is logical that good roads will aid the further establishment of the rural mail, and as distance today is measured by time rather than by miles, good roads with the family automobile and market truck will prove wonderful savers of time. This is important when help is at a premium.

The cost of marketing farm produce plays an important part in agricultural profits. While there are no figures available which can be considered authentic, a careful survey has placed the cost of hauling produce over average country roads at 25c. per ton mile. At this rate 20 miles to market or a cost of \$5.00 for this distance would often take the profit from an otherwise profitable crop. In England the haul cost per ton per mile is placed at 8c. It is a fair conclusion that hauling cost can be reduced at least 50 per cent., and this saving is profit to the agriculturist.

Educational advantages of the farmer are closely identified with the road question. Community inter-

ests are broadened, people are less sectional, ideas circulate more rapidly, neighborhoods are widened, the city and the country are bound closely together, and it is easy to discover that their interests are one and the same. A cash value cannot be placed upon the advantages accruing to the rural section from improved roads. But with a nation's prosperity and future depending largely upon the farm, and the farm prosperity future depending largely upon the farm, and the farm depending in turn upon the highway, road improvement does not remain a local question, but resolves itself into one affecting the very life of the nation itself.

Farmers Have Contributed Much

In the past the farmer has played an important part in building the roads. Much criticism is offered the statute labor system. I am not contending that this system has been perfect, but it has assuredly played an important part in the road building program of this country, and this condemned system operated by the honest labor of the farmer is responsible more than anything else for the splendid network of roads radiating throughout this Dominion, and now waiting to be properly surfaced in order that they may be made the modern convenience, and may play the important part for which they are intended.

I have said that our roads today are largely a monument to the faithful labor of the agriculturist. This has been recognized by governments, and the distribution of cost has been considered an unfair one. The farmer is not the sole user of the road. It is as important that the urbanite reach the country as it is to have the farmer reach the city. The government of Ontario, as well as the governments of other provinces, have arranged a system of assessment and expenditure, whereby all may bear a fair proportion of the cost. Provincial government assistance to roads is a contribution to the agriculturist. The cities responsibility is shown in that suburban areas have been established and in such areas the cities of Ontario have to contribute 30 per cent. of the cost of certain main designated roads.

The importance of agriculture is recognized. The necessity of an equitable assessment of cost is established, and with the early improvement of all our roads, a solid contented constituency will be established within our Dominion, and we will rapidly reach that position among the nations of the world which has been purchased for us by Canada's brave sons on the fields of France and Flanders.

The Electrical Contractors' Association of Montreal, affiliated with the Association of Montreal Building and Construction Industries, has been formed. The association will be a section of the parent concern, with its own officers, constitution, and days for meeting. The president is Mr. R. Moncel, the vice-president, Mr. F. J. Parsons, and the executive committee, Messrs. H. Vincent and J. St. Amour. The preliminary meetings were well attended. The question of an agreement as to working conditions and wages is to be discussed.

The building permits of Montreal for May totalled \$1,269,435, a gain of \$610,755 as compared with the corresponding month last year. This converts a decrease for the first four months of the year into an increase of \$414,000 for the five months, as compared with 1918.

Steam Hammers—Their Selection, Characteristics, Operation and Maintenance

STEAM pile hammers are special tools highly developed for the specific work of driving and pulling steel, wood and concrete bearing and sheet piles. For this service the most improved types are conspicuously efficient, durable, and economical. They are intended only for the specified service and should not be used for other purposes for which they are sometimes proposed, as for instance for breaking up large quarry stones, knocking runners from castings, cutting up pavements and the like. An article on the selection, characteristics, operation and maintenance of steam hammers by C. S. Ackley of the McKiernan-Terry Drill Co. appears in "Contracting" and is reprinted herewith.

Steam pile hammers are the rational development of a power machine to replace the primitive device of a drop hammer that consists of a heavy weight hoisted to a considerable height and allowed to fall between guides, and, striking the head of a pile, deliver violent blows at comparatively long intervals and at such velocity as frequently to cause the destruction or injury of the pile before the energy can be transmitted through the pile to perform useful work.

Steam vs. Drop Hammers

Except for the occasional advantages, usually inherent only on very small or casual operations, of very simple construction, the possibility of being improvised from very ordinary supplies, and the independence of any steam power that enables the drop hammers to be operated by hand, animal or geared power, the steam hammers are practically and theoretically superior in their operation and result.

Steam hammers are especially superior to drop hammers for heavy driving; for deep penetration, for driving inclined piles, for large jobs, for use in inaccessible places; for use in limited headways; for rapid driving; for high efficiency; for adaptability to any kind of work or conditions; for developing the maximum bearing value of the pile, and have besides a great advantage in maintaining and increasing the constant penetration of the pile by means of the static pressure uninterruptedly imposed on it by the weight of the hammer that is supported by the piles continually during the driving process.

Typical Features

Reduced to its lowest terms, the steam pile hammer is a steam cylinder and piston resting on the pile and delivering to it a blow with every stroke of the piston. In some makes the piston forms the hammer and in others the piston is stationary and the entire remainder of the machine serves as a hammer.

There are two principal types of steam pile hammers, the single-acting and double-acting. In the former the expansion force of the steam is used merely to lift the moving part that falls on the anvil with inertia due only to its own weight. In the latter the steam is admitted at both ends of the cylinder alternately, and not only lifts the moving part, but drives it with full expansive force in addition to the weight of the falling

body, thus producing more rapid and stronger action and using a larger quantity of steam.

Comparison of Single and Double-Acting Hammers

The advantages claimed for single-acting hammers over double-acting hammers are the possibilities of somewhat fewer parts and greater simplicity, a reduced first cost, and a smaller consumption of steam power, which in the larger sizes, may be only about two-thirds of that used by the double-acting hammers.

The double-acting hammer is superior to the single-acting hammer in that it can drive inclined piles as efficiently as vertical ones; that it strikes blows with much greater rapidity; that it can strike a very much heavier blow owing to the acceleration by the steam that may be as great as pressure permits; that it keeps the piles in more constant motion, reducing or eliminating the loss of motion between blows, and thus preventing the material through which it penetrates from exerting a positive and rapidly increasing frictional pressure on it; that it requires shorter leads because its vertical height is considerably less, especially in the larger sizes, where it is only about 60 per cent. of that required for single-acting hammers with longer stroke, which thus necessitate considerably greater vertical clearance.

On the other hand, the double-acting hammer has a higher first cost than the single-acting hammer and requires considerably more power for its operation.

General Specifications

All the principal types of steam hammers are made in several sizes, of which the larger ones are chiefly intended for driving larger and longer piles, and for piles that penetrate very difficult soil. With the largest sizes of hammer of either type suitable piles can be driven to a great depth in any material through which penetration is possible, including hard pan. Steel piles have also been driven through large boulders which they split or have been driven until the lower end encountering an immovable obstruction has been deflected and forced upwards till it actually emerged above the surface of the ground.

Single-acting pile hammers weigh from 800 to 16,000 lb., strike from 125 to 50 blows per minute and develop a variable foot-pound energy, proportioned solely to the weight and length of stroke. The largest size is rated for a 40 h.p. steam boiler.

The double-acting pile hammer varies in weight from 145 lb. to 13,200 lb., strikes 500 blows to 140 blows per minute, and when supplied with steam at a pressure of 80 lb. per sq. in., develops a maximum energy of 17,500 ft. lb. stroke for which there is specified a 60 h.p. boiler.

Air and Steam Pressure

Steam pile hammers can be operated either with air or steam without any change or adjustment of the valves. In both cases they are handled exactly the same and their efficiency is substantially unchanged. The small hammers are perhaps a little more lively when operated with air than with steam, and it is frequently convenient to supply them with compressed air instead of steam when they are used for driving

light sheet piles and because a moderate amount of compressed air is often available from the contractors' supply for caisson work and pneumatic tools. For heavy hammers the amount of air required reaches to 600 ft. per minute of air at 100-lb. pressure which could hardly be supplied by an ordinary air plant.

Ordinarily the steam pressure is assumed to be 80 lb. per square in., on which basis hammers are rated and comparisons made. A pressure of 70 lb. will, however, operate the machine. A high pressure affords no special advantage for a single-action hammer, but it greatly increases the energy of the blows of the double-acting hammers which are built to safely withstand pressures up to 150 lb., thus providing for very powerful blows that may be delivered in exceptionally hard driving.

Selection of Hammers

In purchasing hammers several sizes may be advantageous if there is a sufficient amount and variety of work to justify the installation of a large plant and the different hammers can be selected as occasion requires or as the work develops. For general service or for ordinary conditions and when only one or two hammers are likely to be needed it is well to select a hammer of ample capacity for the work in view and with some excess in addition, because extra weight is no disadvantage and is always beneficial when it is necessary, as so often happens, to drive the pile in material harder than was anticipated. The weight of the hammer should be proportioned not only to the character of the soil penetrated, but with allowance for the weight of the pile units driven.

The larger the pile, the larger amount of the energy of the blows will its inertia absorb and the hammer should have abundant power to overcome this and maintain its effective work. The excess weight of this machine is also an advantage on account of the static load it imposes on the pile and tends to keep it continually in motion, thus materially aiding the impact of the hammer. This principle is recognized in the construction of the smallest sizes that are operated by one man who can easily handle them. Their intrinsic weight is considerably augmented by the weight of the operator who usually stands on a step attached to the pile frame for that purpose and thus supplements the kinetic energy of the machine, which in these cases is often driven by air supplied for drills, riveters and other purposes required on other parts of the work.

Application of Hammer

The steam pile hammer requires merely to be placed on top of the pile and maintained steadily in alignment with it while in operation, being supported meantime solely by the driven pile. Very light hammers may be manipulated entirely by hand if they do not have to be elevated to a considerable height or moved long distances. Heavier hammers are supported by tackles, differential hoists and the like and may or may not be guided in leads. They are used in connection with ordinary pile driver towers and leads, with special turntable machines, or any other machines, adapted to the use of a drop hammer, or they may be operated from a radial fixed or movable jib or arm, suspended from a mast or gin pole, from shear legs of a traveler or almost any other suitable fixed or movable support or that may be handled by a derrick boom or the boom of a locomotive crane.

The pile hammer may be used with suspended vertical or inclined leads and even the large sizes may be

used without leads if properly controlled or tag lines, but for the very large and heavy sizes it is preferable to use leads. The single-acting hammers having considerably greater vertical dimensions generally require leads, especially in the larger sizes.

For driving piles below the surface, both single and double-acting hammers use the ordinary followers, but they do not generally require that wooden piles should be banded at the top to prevent splitting or brooming, or that caps should be provided for steel or wooden piles because the anvil forms a block that serves instead of a cushion and distributes the impact throughout the cross section of the piles.

When it is necessary to secure the top of the pile transversely and ensure accurate centering of the hammer, this may be accomplished by bolting shims to the lugs that project from the bottom of the pile hammer, and thus building them up until the required clearance is provided.

For driving pre-cast concrete piles a cushion is, of course, necessary and one made of old rope is found to be about as convenient and efficient as any.

Use of Water Jet

For driving in hard pan, clay and some other materials there is no advantage in the use of a water jet, but in some other strata, sand and gravel, particularly, a jet is of great advantage and may be operated singly or in multiple, attached to the pile, or independent of it, and used with the driving or in advance. A flattened nozzle is considered advantageous and gives a whirling motion to the water, and a pressure of 200 lb. or more is desirable for the best results.

Pulling Piles With Steam Hammer

A great advantage of the double-acting hammer is that by reversing its action it can be made to pull piles with the same facility and about the same speed with which it drives them. This is effected by inverting the hammer and attaching it with a strong connection to the top of the driven pile. If the hammer is maintained in a vertical position and a constant lifting tension is applied to it, its operation will start the pile moving upwards at about the same speed at which it moved downwards at the completion of the driving and after the motion is well established the hammer may be removed and the pile withdrawn rapidly by the use of an ordinary tackle.

This method of pulling has become standard and has been very satisfactorily used on a large amount of important work where piles have been pulled that it was estimated would have required 100 tons tension of a powerful tackle if the hammer had not been operated on them. The pulling is prompt and successful in many cases where ordinary tension or even the operation of jacks would be exceedingly slow or inefficient.

It has been found particularly advantageous in the case of deformed piles or with distorted interlocks, where in order to pull one pile, it is sometimes necessary to pull a group of two or more on account of the binding in the interlocks. It has been successful for piles 50 or 60 ft. long and for those that were firmly embedded in very adhesive soil or that had been bonded to a considerable mass of concrete. Ordinarily they are pulled by a hammer without injury and a very large proportion of them are suitable for re-driving. The harness with which the hammer is attached to the pile must be very strong and well adjusted to endure the severe duty. It may be made of welded steel bars or it may consist of a lashing of steel wire ropes which

is much cheaper and simpler than the welded frame and will suffice for ordinary work, although it cannot easily be made as strong as the welded frame. The frame or harness is often attached to the pile by means of a 2 to 4-in. pin fastened through a hole in the web of the steel sheet pile, but when there is great resistance to pulling this pin may tear through the web without moving the pile. Consequently in some instances double pins are used but obviously do not develop quite double the efficiency of a single pin of the same size.

Care should be taken that the pulling clamp is bolted tightly to the web of the pile as this will prevent the web buckling above the pin and a consequent tearing which often causes considerable difficulty. Sometimes double pins are used, but this will be found necessary only in very exceptional cases if the precaution is followed of properly tightening the clamp on the pile web.

For special work the pulling harness is sometimes attached to the top of the pile by means of mechanical grips that generally combine frictional pressure and a slight penetration of the gripping surface that holds on strongly enough to pull the pile in two in extreme cases.

Care, Maintenance and Operation

The steam hammer should be inspected and oiled and all nuts carefully examined and tightened daily. Difficulty in starting the hammer sometimes occurs on account of bad lubrication. Abundance of clean oil should be used and the oil should be light if the hammer is operated with air pressure. If the hammer is put out of service for storage the principal precaution necessary is to fill the steam chest with oil and to plug the inlet and exhaust ports.

Extreme care should be taken that the oil is introduced as near the hammer as possible, as supplying it through the hose causes an extremely heavy hose expense and hose deterioration is liable to give difficulties through small parts of the hose entering the valve. If the hammer is to be put out of service for storage the principal precaution necessary is to douche the hammer well with oil when hot, being sure that there is no water left in the hammer, and then fill the steam chest with oil and plug the inlet and exhaust.

In operation the side rods, valve and chest bolts should always be kept tight and the full weight of the hammer should always rest squarely on the pile that is being driven. Care should be taken to avoid the use of dirty oil or old hose, either of which are liable to cause obstructions in the valve ports and interfere with the operations of the hammer. The hose should be thoroughly blown out before connection to the hammer.

Life of Machine

The life of a steam pile driver should be 10 years or more of hard work with good treatment. The amount of repairs required is very small and in some cases has been zero for several years of constant service.

The design of the steam hammer has been so thoroughly perfected that during the last five years little improvement has been made except in the use of higher class material and better finish. In the future it is probable that the principal improvements will really be only refinements.

For use in remote localities where communication is slow and supplies are delayed in delivery it is well to

have spare valve gear and sometimes anvil blocks in case of injury or breakage, these being the only parts that need be kept in duplicate.

We know of a No. 7 hammer which has been in practically constant operation for five years without any repairs. Normally about 25 per cent. of our product is exported and during the war we furnished several hundred No. 5 and No. 6 double-acting hammers to the Allies for military work.

Efficiency of Machines

A 13,185-lb. 11B double-acting hammer with a stroke of 18 in. and a height overall of 120 in., operated by a crew of 11 men recently made a record of driving 110 60-ft. wood piles in 8 hr. and drove 1,144 60-ft. piles in the same locality in one month, thus averaging 52 piles or 3,120 lin. ft. of penetration per 8-hr. day. On the same work and under the same conditions the best record made by a single-acting steam hammer was 888 piles or an average of 39 per day for one month. The drop hammers employed on the same work averaged from 14 to 23 piles daily.

A 145-lb hammer drove wooden sheeting 2½ in. thick in the New York subway where the clearance was so small that the piles had to be cut into 5½ ft. sections and spliced end on end to make an ultimate length of 50 ft. which was successfully driven as the excavation progressed.

On important work near Duluth a No. 7 double-acting hammer drove a large number of steel sheet piles through a stratum of limestone 6 or 8 in. thick that offered extreme resistance to their penetration.

Double-acting steam hammers have frequently pulled long piles with great rapidity, sometimes as fast as one in every two or three minutes. In Omaha, Nebraska, several carloads of steel sheet piles 35 ft. long were driven and pulled by a No. 6 hammer. The cofferdam which they formed was partly filled with concrete to which the piles were bonded and above which the back-filling was completed. One of our No. 6 hammers weighing 2,900 lb. will pull a pile driven by a hammer three times as heavy, service that was illustrated in Louisville where piles spliced to a length of 85 ft. were driven by 8,000-lb. hammers and pulled by 2,900-lb. hammers suspended from very long booms on a traveling derrick and a locomotive crane.

In another case the last mentioned hammer suspended by an eight-part tackle from a floating derrick pulled more than 3,000 tons of steel sheet piles 72 ft. long, exerting a force that was estimated to be more than 100 tons and submerged the 50 x 10-ft. derrick scow 3 ft. below normal.

During April the Montreal building permits totalled \$446,470, as against \$648,510 in the corresponding month last year. The total for the four months is \$886,572, compared with \$1,083,325 in 1918.

Mr. Beaudry Leman has declined the offer made by the Administrative Commissioners of Montreal, of the chairmanship of the Montreal Housing Commission, on the ground of not having the time.

In the Borough of Southwark, England, an experimental strip of roadway is being laid, using hard vulcanized rubber blocks. This novelty will be watched with interest by all users of heavy motor vehicles. If the experiment proves a success, the adoption of rubber paving will possibly mean a vast saving in the wear and tear of tires and machinery, due to the absence of vibration.

Trade Incorporations

British Wrecking & Salvaging Company, Limited, with head office at Montreal; capital \$2,000,000.

The Iroquois Falls Housing Company, Limited, head office Iroquois Falls. Capital \$50,000.

Corundum, Limited, with head office at Ottawa, Ont., capital \$250,000, to manufacture metals of all kinds.

Compagnie de Construction des Chemines Pelletier, Limited, with head office at Quebec, P. Q., capital \$25,000.

Regent Metal Goods Limited, with head office at Montreal, P. Q., capital \$75,000, to manufacture steel goods.

Oil Engine Works of Canada, Limited, with head office Montreal, capital \$30,000, for the manufacture of metals, etc.

Mainly Constructional

East and West—From Coast to Coast

The Republic Motor Truck Company are having plans prepared for a \$500,000 plant at London, Ont.

The Department of Public Works, Ottawa, are calling for tenders for a \$100,000 bridge at Banff, Alta.

The city council of Moncton, N. B., have applied for \$500,000 under the Dominion Housing Scheme.

The town of Timmins, Ont., is shortly to commence house-building under the new government loan system.

It is estimated that there are at present about 500,000 men on strike in France, 300,000 of these being metal workers.

Plans for building a memorial hall in Milestone, Sask., are under way and will no doubt mature in the very near future.

A school named "Edith Cavell" to cost \$150,000 is to be erected at Moncton, N. B. The architect is F. N. Brodie, St. John, N. B.

The question of erecting a new freight shed at Hamilton is now under consideration by the Grand Trunk Railway Company.

The C. P. R. Company have been granted permission to build a turntable at Peterboro, Ont., the cost of which is estimated at \$30,000.

The Quebec city council have approved a by-law for the opening up and construction of a road from Grand Allee to Battlefield's Park.

The plasterers at Moose Jaw, Sask., will receive \$1 per hour starting June 1st, according to agreement made with the Builders' Exchange.

With two exceptions, all the workshops of Amherst, N.S., have been closed by strikes. The situation, from an industrial standpoint, is grave.

The County Council of Lancaster have decided to submit a by-law to the ratepayers for approval of borrowing \$100,000 for new township roads.

Irrigation work on the 22,000 acre tract, recently acquired by the British Columbia government for soldier settlement purposes, will commence immediately.

Work preliminary to the construction of the Canadian National Railway line through New Westminster has now reached the point of grading the right of way.

The civic employees of Galt, Ont., have decided to accept the Board of Works' offer of an eight-hour day and wage of 45 cents an hour to all men who have been receiving the

maximum of 36 cents an hour. Men who have been receiving less than 36 cents an hour will be paid on a sliding scale from 35 to 45 cents an hour.

An appropriation of \$750,000 has been voted for improvements in the harbor of St. John, N. B.; also \$300,000 for harbor and river improvements at Port Arthur and Fort William, Ont.

The Housing Commission of Galt, Ont., has had its four and six-room housing plans approved by the Provincial Director and will now go ahead with the land purchase and construction problems.

The Toronto carpenters have not yet reached an agreement with their employers. The men recently turned down an offer of 67½ cents per hour. They are demanding 75 cents an hour and a 44-hour week.

The question of building a new City Hall as a war memorial is under discussion in St. John, N. B. The mayor will shortly call a public meeting in order to get an expression of opinion from citizens in general on the matter.

The city of Fredericton, N. B., has decided to seek legislation which will enable a policy to be brought about whereby a sum of \$200,000 will be raised by debentures and expended over a period of five years on permanent streets.

Considerable ditching work is in progress on the Hamilton to Queenston provincial highway. Permanent surface repairing is not being done in view of the possibility that the road will be put under construction in the immediate future.

Work of deepening the compensation well at the pumping station at Point St. Charles, P. Q., is now under way. This work when completed will result in an increased supply of water for the city of Montreal amounting to 25,000,000 gallons per day.

Vernon, B. C. proposes building a war memorial building, which will comprise a gymnasium, swimming pools, rooms for the exhibition of war trophies and a large assembly hall for the free use of the G. W. V. A. The estimated cost of the building is \$50,000.

The city council of Chilliwack, B. C., and the provincial government have reached an agreement whereby the expense of hard-surfacing the Yale road through the city will be shared equally. The road is to be 18 feet wide and of rock and tar with a tarvia finish.

The Bell estate, Christina and Victoria streets, Sarnia, Ont., has been selected as the site for the new \$75,000 theatre, which the United Theatres intend building. The theatre will have a seating capacity of from 1,200 to 1,500 and will be one of the most up-to-date in Ontario.

A building boom is on in Brantford, Ont. Permits have already been issued for 126 homes and there are over 100 applications for loans from the housing commission in addition. To date \$377,000 in permits have been issued, which is more than the total for the years 1916 and 1917 combined.

Plans for a new hatchery to be built by the government at a cost of \$30,000 at Lakelse Lake, near Terrace on the Skeena river, B. C., have been submitted to the Department of Marine and Fisheries by Lieut.-Col. F. H. Cunningham, Dominion inspector of fisheries.

The Ferro-Concrete Ship Construction Company will shortly cease operations at their shipbuilding yard at Barrow, England. This company was formed in 1917 to fulfil the urgent demand for freight vessels. Hopes are entertained for a new steel shipbuilding industry on the same site.

The Women's Department, Canadian Reconstruction Association has published a little pamphlet called "Better Houses for Canadians." It is an appeal for the co-operation of women in house planning and a review of various Government proposals. It contains many interesting points on bet-

ter housing and can be obtained upon request from the offices of the Association, Royal Bank Building, Toronto.

Draft of the new building by-law has been completed by City Architect Pearse, Toronto, and has been presented to City Solicitor Johnston, who is carefully going over it to see that everything is in proper shape. A special committee of the council will then consider it clause by clause, after which it will finally be presented to council.

A delegation from the Fort William School Board will wait upon the city council with a request for \$75,000 for public school building purposes. Russell Brothers' tender of \$36,621 was accepted for the building of the addition to the Ogden school, while N. Russell and R. McMahon received the contract for the building of the addition to the Francis street school. This will cost \$58,600.

Yorkton, Sask., is to have a new Ruthenian school this year. The building is to be a three-storey brick structure with a deep basement. The dimensions are 60 by 100 feet, and the cost is estimated at \$100,000. This will be the second large building for Yorkton this year. The government of Saskatchewan is constructing an up-to-date court house at this point, the cost of which is estimated at upwards of \$100,000.

At the annual meeting of the Canadian Malleable Iron Company, Owen Sound, Ont., a new Board of Directors was elected, denoting a change in the financial control of the company. Mr. D. J. Kennedy was elected president; M. Kennedy Sr., vice-president; I. Guttenkunst, manager, and Messrs. T. D. Kennedy, Mr. Kennedy, Jr., and E. Lemon are directors. The offices of the company have been moved to 1020 First Ave. West.

The Ontario Wind Engine & Pump Company is erecting a new office and warehouse building at the corner of St. John Street and Eighth Ave., Regina, Sask., increased space being made necessary by the larger volume of business which the firm is handling. The structure is of red brick, one storey, 60 x 120 ft. Regina is the headquarters of the firm for Western Canada, branch offices being located in Winnipeg and Calgary.

At the annual dinner of the North Vancouver Board of Trade, held recently, a resolution was adopted requesting the provincial government to make a survey and estimate the cost of completing the scenic highway between North Vancouver and Lillooet. Mr. Kent, who addressed the board on this subject, estimated the cost at approximately \$1,500,000, an average of \$9,400 per mile for the entire 160 miles. Thirty-five miles of this road have been built, 55 miles need only repairs and 70 miles of new road will have to be built.

A housing commission has been appointed in Niagara Falls, Ont., its members being: Rev. Major Guy B. Bordon, returned soldier, nominated by the G.W.V.A.; John Logan, merchant; John Blair, contractor and W. L. Wilkinson, insurance agent. A town planning commission has also been formed composed of: Arthur A. Kinzinger, M. R. Meldrum, manufacturers; J. H. Jackson, superintendent of Victoria Park; F. H. Leslie, newspaper publisher; W. H. Carroll, bank manager, and A. E. McEvers, merchant.

Among the projects will go forward this year in London, Ont., are a military hospital; home for incurables, \$75,000; a hosiery factory, \$250,000; knit goods factory extensions, \$50,000; medical school, \$200,000; two theatres, one of which is to cost \$200,000. Prospects are considered to be fairly bright for the beginning of construction of a new City Hall during this year. Plans already prepared are for a four-storey building that will cost \$200,000, and tentative plans have been made for a five-storey building that will cost \$256,000.

The project for two bridges over the Ottawa River, from Montreal Island to Isle Perrot and thence to the mainland

at Vaudreuil, is receiving considerable support. These bridges, it is pointed out, would link Montreal with Ottawa and with Toronto, and, though within the Province of Quebec, would really be inter-provincial bridges and as such would have claim to federal financial assistance. The Board of Trade of Cornwall, Ont., is pushing the scheme, and the council of the Montreal Board of Trade has decided to support them in their action.

The steamer "Concretia," a concrete ship, the first to arrive in Toronto, recently docked at Yonge St. wharf. Launched at Montreal last summer she was completed at Prescott and started on her first trip this spring. She is in the service of the Dominion government and is placing gas and spar buoys. Though the upper works are of wood, the deck and whole of the hull are of concrete. The hull is painted grey but marks of the forms can be plainly seen. The boat has a draught of 11 ft 8 inches, its length is about 120 feet and its normal speed is seven to eight miles.

Toronto is to have a Pantages vaudeville theatre, the largest and best in the Dominion. It is to be erected on Victoria street, between Shuter and East Dundas, and will have an entrance from Yonge street, just south of Dundas street. It should be ready for the first performance on Jan. 1, 1920. Alexander Pantages stated that the new theatre will be the most handsome structure in Canada, and the last word in theatrical construction. The plans are in the hands of Thomas W. Lamb, who has designed some of the finest theatres on the continent. The building will cost approximately \$600,000.

The houses which the Toronto Housing Commission are building on Coxwell Avenue are to have brick basements, stucco on the first floor and clap-board on the second floor. They will have spruce floors, heavy table oilcloth on the kitchen and bathroom, dadoes, combination sink and tub and kitchen dresser supplied. Each semi-detached house is to be 19 feet wide and the dimensions are as follows: First floor—Porch, 6 x 6 ft.; dining room, 8 ft. 3 in. x 11 ft.; living room, 14 ft. 3 in. x 9 ft. 6 in.; hall 4 ft. 6 in. x 10 ft.; kitchen, 10 ft. 9 in. x 11 ft.; second floor—bedroom, 9 x 13 ft.; bedroom, 11 ft. 3 in. x 7 ft. 6 in.; bedroom, 7 ft. x 9 ft. 3 in.

GOOD ROADS ACTIVITIES

The construction work on the provincial highway will be carried on by the Ontario Highway Department. It has been intended to have this work done by contract, but tenders submitted by contractors for that section of the highway between Rouge Hill and Whitby were 50 per cent. higher than the department expected they would be. On this account the department has decided to go ahead with this work itself.

A good roads deputation of Peterborough, Ont., citizens, consisting of Messrs. Bradborn, chairman; H. O. Fish, secretary; C. Rogers and R. Denne, met the council of the township of Monaghan at Centreville to discuss the taking over of the Peterboro'-Port Hope road as a Provincial Highway. The South Monaghan council unanimously passed a resolution petitioning the Ontario government to take the road over. The council are enthusiastic on road matters, and are anxious to secure their share of provincial and federal moneys to be spent on road improvement.

Personals

Sgt. Arthur J. Bird has been appointed building inspector of Vancouver.

Major General Wilson has been elected a director of P. Lyall & Sons Construction Co., Ltd., Montreal.

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Urgent Action Wanted on Federal Aid Measure

SINCE the announcement was first made of the Dominion government's proposed intention of providing financial assistance towards highway construction, the provinces, among which the stipulated \$20,000,000 was to be divided, according to population, have been making plans for road building on a scale which is, to a large extent, dependent on the anticipated federal aid. So strongly have hopes been built upon the supposedly unquestioned success of the bill at the present session of parliament, that highway programmes throughout the Dominion received an impetus that provincial or municipal effort alone, without the assistance of federal authority, could possibly never have given. It was everywhere recognized that the promulgation of road building schemes was a means to an end at this critical period when national life had to be stabilized and an outlet provided for the great labor forces that were relinquishing abnormal war-time occupations. Much as it was realized that road construction was an economic necessity, the one handicap was high costs—it is very creditable, however, that this did not deter the highway authorities, municipal and provincial, as much as it might reasonably have done. When the Minister

of Railways announced his federal aid measure, therefore, it was immediately taken up by the provinces as a means of making better roads and more of them. Forthwith plans were revised to take advantage of the assistance, in the hope and confidence that the grant would be forthcoming.

With parliament, however, just short of its prorogation, and the bill with but one reading, there is more than a remote possibility of its being set aside until a subsequent session. It is understood, further, that there is sufficient opposition on the part of individual members of the House to preclude the certainty of the bill being enacted.

The possibility of the scheme being pigeon-holed was recognized at the recent Canadian Good Roads Congress, where the Minister of Highways and other representatives of the provincial governments took the opportunity of holding a meeting to discuss the question and expressed themselves as unanimously in favor of the proposal. It was decided that when they returned to their respective provinces, each should get in touch with, and enlist the support of, the members of the federal government in his province, to make certain of securing the national grant.

A further recent effort to secure action in the matter has been made by the Canadian Automobile Association, the central body of the various provincial motor leagues, in a letter urging all automobile clubs, boards of trade, municipal councils and other organizations interested in the good roads movement to take speedy action to impress upon the Dominion government and the members of parliament the desirability of passing the federal aid bill. The letter advocates that these bodies pass resolutions for presentation to the government, write personal letters to the cabinet ministers and private members and otherwise bring all possible influence to bear to ensure the early passing of the measure.

The situation is obviously one that demands the most earnest efforts of all friends of good roads. Immediate action along these lines is imperative, as the present session is nearing its close. Highways are not local attributes, but national assets, and federal aid is, in a measure, the recognition of national responsibility in the construction of a transportation system that serves a national requirement. The government can well be urged to consider the federal assistance measure with all haste—now is the time, not next session. The provinces and the people at large want to know the Dominion government's attitude—they cannot afford to hesitate in the formation of their plans, for road building is urgent and the season is already on the wane.

Heavy Loading, and Quick Release—Two Railroad Improvements That Ought to be Adhered to

A BULLETIN issued by the Canadian Railway War Board draws attention to two railroad lessons taught by the war—the heavy loading of freight cars and their quick release. The value of these improvements in railway service is emphasized and the railways and the public are urged to stand by these two useful practices which have been developed under pressure of emergency, but which ought none the less to be adhered to in these days of peace.

It is pointed out that 1919 average load per car was increased by 7 tons over the 1914 loading. By

this action the net freight hauling capacity of an engine has been augmented by 15 per cent. To the railways this heavy loading meant: (1) fewer engines hauled a greater amount of traffic; a greater number were free for extra trains or for emergency uses; (2) fewer cars were required for any given amount of traffic; (3) each act of every department employee had a higher efficiency. To the shippers and general public: (1) it increased the railroad capacity of the country; (2) it reduced their risk of delayed shipment; (3) it mitigated the seriousness of delays—if any; (4) it speeded up all business; (5) it laid the ghost of general railway congestion.

An example is given of the efficacy of quick release in reducing congestion and minimizing track requirements of terminals. Forty feet of track room is needed for every car, loaded or not, and for every day's delay in releasing one car, 40 feet of terminal track capacity is held. If an appreciable proportion of the shippers and consignees in shipping centres hold cars one day longer than usual, the track capacity for the tonnage handled and for the empties awaiting return soon amounts up into miles.

Heavy loading and quick release of cars work with double effect, for if freight imported and exported from a city is loaded by 1914 standards—7 tons less per car—there is an accrued effect of more cars, more engines and more track necessary to handle the traffic.

So beneficial have the heavy loading and quick release improvements been that the Canadian Railway War Board urges the transportation companies and the shippers and consignees to take precaution to offset any tendency to return to former ineffective methods.

Benefits Accruing from a National Highway System

FOUR benefits that will accrue from the establishment of the national highway system are given in a report of the National Highway Committee of the American Road Builders' Association. These are (1) political or spiritual, (2) economic, (3) military, (4) benefit of the example which the national system will set for all highway construction and maintenance.

By political benefit is meant the welding together of the people which comes from the obliteration of sectional lines and the realization that we are not a collection of heterogeneous people, but a single nation. This breaking down of sectional lines can be brought about only by improved methods of communication and transportation, such as the telegraph, telephone, railroad and the highway.

An economic benefit will result from the establishment of motor truck roads, radiating from the large cities and forming an agency of commerce across wide areas of the country.

The third benefit of national highway system is that which would be derived in case of military emergency. All of the trunk lines may become military highways and we cannot afford to neglect one of the essential means for the transport of materials and men—the highway system.

The building and maintenance of a highway system will furnish an object lesson to the citizens in every part of the country. The national government would be unhampered in the selection of roadway surfacing and in the methods of maintenance. In all of

these respects the standards would be the highest warranted by present day traffic conditions and such routes, coming under the personal observation of thousands of citizens, would set a standard for roadwork that would be of inestimable value in the development of adequate local highway systems.

Attitude of Montreal Building and Construction Association in Regard to Working Hours

AT the monthly meeting of the Board of Directors of the Association of Montreal Building and Construction Industries, the secretary submitted an analysis of the replies he had received as a result of the questionnaire issued to the members a few days ago. This invited the opinion of each member in regard to the number of working hours he deemed essential for the efficient and economical working of his particular branch of the building industry; and further asked if his firm was in favor of making agreements with organized labor as to wages and working conditions, and whether labor unions should, before agreements are made with them, be incorporated. All the replies, it was stated, had not yet been received, but sufficient had come forward to enable the Board to form a conclusive opinion of the views of the largest employers of labor in the building trades on these matters. Of the firms who replied, 83 per cent. emphatically favored the operation of a nine-hour day and 12 per cent. favored the operation of an eight-hour day. A six-hour day appealed to none, and some of the members declared their disapproval of the suggestion in very clear and expressive phrases. Further, 74 per cent. were in favor of the various sub-sections of the Association making agreements as to wages and working conditions with organized labor; and all of these insisted that before this was done the unions concerned must be incorporated and in a position to implement fully the contracts entered into with organized employers.

One of the members in his covering letter stated: "With a short season such as we have in Montreal, where we can only figure on about five months to work in, not counting the bad weather, we cannot see any reason why the men should not put in ten hours a day. Another disadvantage the reduction in hours would mean, not only to the contractor but to the proprietor of the work, is that teams are just as well working ten hours a day, and in all probability will be charged up on that basis." Another member stated that a number of his workers, union carpenters, wished to work ten hours a day, while another stated that the farmers around Vankleek Hill intended to adopt an eight-hour day if the same were adopted by workers in the city.

Outremont City Council have awarded prizes of \$150 to each of the following architects taking part in a competition for designs of double cottages, the cost of which will range between \$10,000 and \$15,000: Messrs. A. Doucet, A. S. Houle, Bigonnesse & Bigonnesse and Gadbois & Perrault (the latter two prizes). A third prize will be awarded Messrs. Gadbois & Perrault if certain plans are handed over to the council. Each prize covers the fee for the plans of a double cottage. The council have decided to go ahead with five cottages as part of the scheme. The Province of Quebec Association of Architects objected to the competition as not being in accordance with their code and unjust to the profession.

Regional Planning of the Niagara District

Paper by Thomas Adams, Town Planning Adviser to the Canadian Government, before City Planning Conference, Niagara Falls, N. Y.

IN order to plan out cities and towns properly we must investigate and analyze many problems which have a bearing on life and growth within and surrounding them. What is true of the individual is still more true of the city. It cannot and does not live to itself alone. Recent events throughout the world have shown the extent to which the town and the country are inter-dependent. Recent tendencies in industrial decentralization have also shown the importance of one of the modern aspects of town planning, namely, the direction and control of the growth taking place within the rural and semi-rural districts where new industries are being established. The artificial boundaries of cities are becoming more and more meaningless. The real controlling factors which determine and encourage industrial growth are physical and natural to a greater extent than they are administrative and artificial.

Regional Plan and Regional Survey

One of the difficulties in dealing with this subject is that we have not yet adopted a clear and unambiguous terminology. The same words have different meanings to many of us. I must, therefore, begin by explaining what I mean by regional planning and regional survey, and I will take them in the logical order:

1. The Regional Survey has to do with the investigation and mapping of the existing physical, industrial and residential features of a region that has interests and problems in common, which needs comprehensive and co-ordinated treatment without regard to arbitrary administrative boundaries.

2. The Regional Plan is concerned with the general planning of the area included in a regional survey. It is a skeleton and tentative plan of a region within which there is comprised a series of municipal units, in juxtaposition to one another, and having overlapping and inter-related problems. The width, direction and classification of our main and secondary highways should be governed by the needs of such a region and not by the needs of one municipality within it. This principle is fully recognized in Ontario highway legislation, in regard to the principle on which the cost of construction is apportioned. The planning of our system of communications in the regional plan should also have regard to the classification of land for different purposes of industry or residence. Land should be classified in a general way for industries, for residences, and perhaps for agriculture, for park areas or for special reserves or as unsuitable for building purposes. We would also consider within the region how far it is desirable to prescribe a code of housing and town planning regulations to deal with building conditions that need to be dealt with in common over large areas of different character. Sewerage and water supply may have to be dealt with in large regions to obtain efficient and economical schemes in cases where it is not practical to get an efficient system of either in separate units of administration. These and other problems that can be dealt with in a preliminary and general way need regional, rather than municipal treatment.

3. The Town Plan is the definite plan, accompanying a definite piece of legislation, for fixing within the city or the county areas first those parts of a regional plan which are locally approved, and secondly, the civic design and regulations dealing more intimately and precisely with the problems connected with the growth of the town, its means of communication, its industrial development, its residential areas, its character and density of building, etc.

We thus have three distinct processes, each connected with one another, and logically leading up to one another, which are the Regional Survey, the Regional Plan and the Civic Plan. It is unnecessary for me to argue with town planners how hopeless the task is to attempt to prepare a plan without having obtained accurate data regarding existing physical and industrial conditions.

The Problems of the Niagara District

The Niagara district seems to me to be one which needs the making of a regional survey and a regional plan as a preliminary to a series of civic plans for its city, town and county areas. Neither Buffalo, nor the Tonawandas, nor Niagara Falls, are strategic centres; they are parts of a strategic centre of 1,000 square miles in extent on both sides of the Niagara River. The problems of this region are international, and give us proof that the power of natural conditions is so great that even the boundaries of nations do not form intelligent and appropriate boundaries to regional and town planning schemes. Indeed, may we not hope, that in the process of planning them we shall help to knit these two nations, their industries and people, closer together; and also that the bridge which we propose to erect as a symbol of peace will be more than that—will be a symbol of co-operation and mutual respect? Personally, I should like to see something more than a physical bond, such a bond as could be provided by a Regional Planning Commission representative of the State of New York and the Province of Ontario to deal with the planning problems of the Niagara district. That need not be an idle dream any more than the creation of an International Waterways Commission.

Superficial study of the problems which need to be dealt with within the Niagara region has convinced me that the whole district, for at least 20 miles on either side of the Niagara River, needed to be made the subject of a regional survey. The Niagara district is one with enormous potentialities for future commercial development. It has a strategic position of great importance to both our countries, and it has certain advantages as a tourist centre which are sufficiently in conflict with the aims of those who are interested in its industrial expansion to make it important that a survey be made before any definite plans are adopted by any municipality within the district.

Area and Population of Niagara District

What I call the Niagara District comprises approximately 20 miles on either side of the Niagara River for a length of 28 miles between Lakes Erie and Ontario. Further west in Canadian territory an-

other regional area has the city of Hamilton for its centre. In the United States the area covers all the county of Niagara with the exception of the towns of Somerset, Hartland, and Royalton, and in county of Erie includes the towns of Tonawanda, Amherst, Clarence, Cheektowaga, Lancaster, West Seneca and Grand Island. The total area is over 700,000 acres, of which about 317,000 acres are in Canada and 418,000 acres are in the United States. The present population is estimated at about 751,600, made up of 86,700 on the Canadian side and 604,900 in the United States. Buffalo is not the geographical centre of the region, although it is the predominant partner among the local units by reason of its size. Further consideration might lead me to include more of the southern environs of Buffalo to a distance of 10 miles from its centre.

Including all towns of less than 7,000 population, the rural population on either side of the border is about directly proportionate to the rural area, being about one person for a little less than 7 acres on the Canadian side, and one person for a little over six acres in the United States. The densities of Lockport and the Tonawandas are very low, being only about 4.5 persons and 2.7 persons respectively per acre. An estimate of the population gives 1,170,000 for the Niagara frontier regional area in 1950. It has been considered that the rural population would remain unchanged, and the estimate has been based on future growth curves of the combined total of three Canadian cities in the region and six of the regional cities in the United States.

Consolidation Desirable

A study of conditions shows that cities are growing along the Niagara frontier and the Welland Canal, so that their boundaries are being forced out to meet the smaller towns. For example, Lasalle is now really a residential part of Niagara Falls, N. Y., but Niagara Falls has no control over its development, although the boundaries of these two places are now adjacent. Consolidation is considered desirable in these places as well as in St. Catharines, Merriton and Thorold; Lancaster and Dewey, partly industrial and partly residential, have similar problems; Bridgeburg and Fort Erie, Port Colborne and Humberstone are other cases in point. Then there is the larger question of what areas will soon be incorporated in the city of Buffalo. Evidently there is great need for some definite control over suburban areas, or looking further into the future, areas that are to become suburban areas, and eventually urban areas.

Purposes and Principles in Regional and Town Planning

For what purposes do we require more accurate information and what are the usual problems that have to be dealt with in planning a large region? We may summarize these purposes and problems as follows:

1. Industrial development—including the arrangement and classification of all lands and the location and distribution of manufacturing plants.
2. Economic use and regulation of the sub-division of land and the character and density of structures in rural and urban areas.
3. Housing—sanitation, convenience and amenity.
4. Transportation—railways, highways and waterways.
5. Sources and distribution of power.

6. Water supplies and sewerage.

7. General amenities—including parks and boulevards and development of tourist facilities.

I will now proceed to consider some of those principles in relation to the problems of the Niagara district.

Industrial Development

In the Niagara district the varied character of the soil and its great fertility in the rich valleys, make it of special importance that the system of distribution should be of the best kind to encourage the maximum of agricultural production. Being an old settled region it is probably impracticable to carry out any schemes of re-planning or re-classification of the lands. It is in connection with the growth of manufacturing industries that the chief problems occur. The combination of cheap power, adequate transportation facilities, and reasonably priced land are having their effect in promoting rapid manufacturing development in the region. As an example the town of Welland had only five factories five years ago and now has thirty. In the cities and towns on the Canadian side there are 145 manufacturing establishments, and on the United States side 183 outside of Buffalo. The manufacture of cereal foods and the canning and preservation of fruits and vegetables are carried on side by side with the manufacture of aluminum, calcium carbide, etc. Too little regard has been paid even in recent years to regulating the location of objectionable industries, and great and perhaps unnecessary injury has been caused to the great asset of scenic beauty possessed by Niagara Falls. The need for zoning is evident to the casual observer; the methods of carrying it out require prolonged study so as to avoid injury to industrial development.

The low-lying land to the north of the escarpment and also including the area for a few miles south of the escarpment on the higher land is excellent soil and well suited for fruit farming. The balance of the region is only at Lake Erie level, and presents some drainage problems especially in the clay strip that runs through the centre of the region. On the Canadian side, near Lake Erie, shallow soil is also encountered with limestone outcroppings near the surface, and peat bogs are also encountered. Generally speaking, the level area which is given up to dairying and general farming, has not been developed up to the possibilities of the soil.

Housing Situation

Generally speaking, no protection is afforded to residential areas in the region, and sanitary conditions are defective in districts occupied by workingmen's families. There is an estimated shortage in the cities, not including Buffalo, in the region of about 2,350 houses. Taking the figure of 2,350 as the shortage in houses and an estimated population of 168,000 it will be found that for every seventy people there is another house needed.

A survey of housing conditions is needed not only to ascertain facts with regard to the shortage, but also to find out the best means of raising the standards of existing dwellings and improving sanitary conditions.

Railway Situation

The numerous railways that serve this area make it a great railway centre, and perhaps unrivalled for rail transportation facilities. At Gardenville Gravity freight yards, near Dewey, some \$25,000,000 is to be

spent, and the yards completed in the next ten years; \$6,000,000 has already been appropriated.

At the Lake Erie end of the region there is only one railway bridge, and that single tracked. Trains are said to cross at the rate of one about every seven minutes, and there are 15,000 cars of merchandise passing through every month. The C.P.R. may consider it desirable to build bridges at Goat Island to cross the Niagara River and give them their own bridge entrance into Buffalo.

As far as the cities and towns are concerned, the greatest problem is that of grade separation. In this matter the railways have had the upper hand in the past, and it is time that the general interests of the public were safe-guarded in connection with railway enterprises to a greater extent than hitherto. But it is not the railway corporations that are to blame; the fault lies with the local authorities in not taking action in time. Portions of Niagara Falls, Ontario and Niagara Falls, New York, are practically devoted to switching, and this right on some of the busy streets. For example, in Niagara Falls, Ontario, there are 14 level crossings. It would be an advantage to have the tracks of the electric radial railways moved from the central streets of cities and towns in certain cases. In other cases, streets are too narrow for double track-ing.

Highways and Waterways

Even a preliminary survey of conditions on the Canadian side, across from Buffalo, would seem to indicate that that area is being hampered in its development by the lack of a highway bridge. A "Peace" bridge has been proposed as a memorial, and it is stated that bills are now before the Governor of the State of New York, one for a bridge at Buffalo, and one for a bridge at Niagara Falls. Apart from the question of the peace bridge there is no doubt as to the need for a bridge at Buffalo across the Niagara River, but the means of communication on both sides of the river need to be studied before the site of the bridge is settled.

The Niagara River, as a waterway between Lakes Erie and Ontario is, of course, impossible for navigation. On the Canadian side the Welland Canal provides a waterway between the lakes.

The great improvement which is taking place in regard to the waterways which feed the district will be certain to greatly increase the population and industries of the region in the near future, and they will also tend to create changes in regard to local conditions of development and settlement of land. A regional survey and plan is needed to deal with expected growth, and change of conditions even if no other development of transportation facilities were taking place. It is also important, as we shall see later, to consider the park system of the region, and perhaps the drainage system also, in connection with the abandonment of old waterways.

Power Situation

The rapidity with which the demand for electrical energy has grown is indicated by the fact that the first modern power development at Niagara Falls took place in 1890, with an initial installation providing for the production of 100,000 h.p. At the present time the total production is 650,000 h.p. At Power Glen, adjacent to St. Catharines, there is also a development of some 52,000 h.p. There is also under construction a plant to produce an additional 400,000 h.p. The principal development is that of the Hydro-

Electric Power Commission of Ontario, which is constructing a canal $8\frac{1}{2}$ miles long to divert the flow of 10,000 second ft. of water and provide for the ultimate development of 300,000 h.p. at Queenston. This enterprise will cost \$25,000,000 and will not be completed until 1921.

There has been some criticism of the construction of the open cut, which is having an injurious effect on adjacent property, and will make the city of Niagara Falls, Ont., an island. Whether this criticism is justified or not, and whether part of the canal should have been in tunnel, as apparently would have been practical, does not concern us, but the fact that it is made shows that no such scheme should be carried out without careful study of all the factors, including those outside the purview of the Hydro-electric engineers, before this kind of enterprise is begun. The day should be past when great corporations, whether railway or power companies should be permitted to ignore the effects of their enterprise on the industries, property and lives of the community as a whole.

Water Supply and Sewage Disposal

Lake Erie is the source of water supply for the urban population in this region, being obtained either via the Welland Canal or the Niagara River. There is pollution of the Niagara River, practically none of the cities or towns treating their sewage. This pollution will be increased, with the completion of the Welland Ship Canal, and the entrance of the water from the Welland River into the system. It has been decided to have a pipe line extending from Lake Erie to Lake Ontario to supply the cities and towns along the Welland Canal with water.

The pollution of the Niagara River has been a matter of consideration for the International Joint Commission, and recommendations have been made by their engineers. Evidently the situation needs early attention.

The Tonawanda Chamber of Commerce is considering a scheme of sewage disposal for their whole area. Mr. F. W. Barrally, city engineer for Tonawanda, has done some preliminary work on this scheme, which it is claimed, provides for sewage disposal and drainage of the outlying area along the Niagara River, and incidentally for the development of power. It would avoid the very serious pollution of the Niagara River, and would use the old Erie Canal as a drainage canal for sewage from Buffalo to Tonawanda. There is urgent need for study of the sewage disposal problem of the whole district so as to get an economical and efficient system.

Parks and Tourists

Both the rural and urban areas seem to be deficient in parks. It might almost be stated that the cities and towns have no parks. An estimate had been made that from 1885 to 1907, 15,000,000 visitors have viewed Niagara Falls. In spite of all that has been done it cannot be said that sufficient care and vigilance has been taken to preserve the remarkable scenic beauties of this region, or to regulate industrial development so as to prevent injury to the amenities of the district, with loss of convenience or efficiency. The commercial value alone of the great combination of natural and historic features is such as to justify the expenditure of more money and effort in conserving them. At old Niagara, with its large "Commons," there are points of historic interest, and the ruins at

Fort Erie at the southerly end of a possible park system should also be preserved.

But it is a regional and not a local problem. The district has been endowed by nature with exceptional gifts, extensively as well as intensively. People should be attracted here to spend days instead of hours. All these matters I have referred to create one big problem that requires big men to solve it and raise it above the level of the politics of the village pump. The whole question of the development of this region in all of its ramifications is big enough to be dealt with internationally. As an immediate practical measure I suggest that a permanent conference or a joint town planning commission of representatives of all the municipalities in the region, be created to prepare a re-

gional survey and a general plan for the area; that federal, state and provincial aid be invited towards the preparation and carrying out of a comprehensive scheme. This need not be done in any way that is unconstitutional, or so as to interfere with local autonomy. It need not involve that any municipality now engaged in preparing its own scheme suspend its operations, but merely that it recognizes that it is only part of a greater whole, and that whatever it does should be made to fit in with a general plan of the region.

Apart from all other considerations would it not be a good thing for our two countries to be definitely linked together in a work which is so much needed, and has so much promise and opportunity?

To Construct Bituminous Macadam Roads

When Properly Built Will Prove Economical Type Where Traffic is Not Too Heavy — Read at Canadian Good Roads Congress

By A. W. Dean*

A BITUMINOUS macadam pavement is one having a wearing course of macadam with the interstices filled by a penetration method with a bituminous binder. Such pavements were built in a rather crude manner in England and France in the early part of the nineteenth century, but were nowhere extensively built until little more than ten years ago, when the change in vehicular traffic and consequent increased destruction of waterbound macadam pavements made necessary the construction of a surface to withstand the new destructive forces on the roads. The year 1908 marks the real beginning of this type of pavement, although a few small experiments or attempts were made previously. The first results achieved, while at the time appearing successful, were not durably satisfactory, due to the fact that improper materials and workmanship were used. Further experimental construction and careful observation of results obtained by varying the character of material and method used have resulted in a widespread use of this type of pavement at the present time, and when properly constructed it has proved to be an economical type where the vehicles to be propelled over it are not extremely heavy.

In the construction of this pavement, as in that of any so-called permanent type, proper drainage and foundations are absolutely essential. Moisture and frost action under the road crust are just as destructive as in the cheapest or most expensive pavements. If the subsoil is a gravel or suitable sand, no artificial foundation may be necessary, but if of clay or other improper material, a foundation course consisting of stone or coarse gravel should be placed. If of stone, the interstices should be thoroughly filled with gravel to prevent the clay subsoil from gradually working up and filling the voids in the stone, thereby permitting the moisture to permeate and destroy the foundation and pavement during frost action.

The First Course of Broken Stone

Upon the properly prepared natural or artificial foundation the first course of broken stone should be spread evenly and to sufficient depth to be of the desired thickness after rolling. No universal rule can be made covering the thickness of this course, as the

local conditions vary so extensively. For example, in some localities, the subsoil is of such a nature, and the materials available in the immediate vicinity are of such a character that an artificial foundation of stone ten inches or more in depth may be laid and the first course of the pavement need be only about two inches in thickness. This is economical and satisfactory in localities where suitable stone for foundation is plentiful, but stone suitable for the first course of the macadam has to be imported at considerable expense. On the other hand, if the subgrade is a proper one, so that artificial foundation is not necessarily used, the first or bottom course of the macadam should be not less than four inches in thickness after rolling, and, if heavy loads are to be sustained, a thickness of six inches is desirable.

The stone in this course should be of uniform and good quality, and should be spread in such manner that there may be no segregation of large or small stone. The stones composing this course may vary in size from one-half inch to three inches in their longest dimensions, provided, however, that the percentage of the small size shall be very small. If the course is four inches or less in thickness, the best results are obtained, however, by using stone varying in size from one and one-quarter to two and one-half inches. The same minimum size is preferable in a six-inch course, but the maximum size may then be three inches.

Somewhat Like Water-bound Surfaces

In laying this course the same methods should be used as in the laying of ordinary water-bound macadam, including thorough compaction by rolling, and securing a uniformly smooth surface. Unlike the first course in waterbound macadam, however, the voids in this first course must be filled with stone dust, fine gravel or sand, in order to prevent wasting of bitumen by penetration into this course during the construction of the top course. It is essential that the surface of the bottom course be even and without depressions before laying the top course. After the construction of this course is completed, all surplus dust and fine material should be swept off, leaving the upper stones bare to receive the second or bituminous course.

After the completion of the first course, as above set forth, the second course is spread at such thick-

*Chief engineer, Massachusetts Highway Commission.

ness that it will be two inches thick after rolling if for medium or light vehicular traffic, or three inches thick if for heavy vehicles in large volume. It is extremely important that the stone used in this course be of good quality, uniform in character, and so spread that there is no segregation or large or small sized stones. If building for light-weight vehicles only, the stone used may have a French co-efficient of wear as low as eight and a hardness value of eight, but for heavy vehicles a better quality of stone should be obtained if possible, using in such case a stone having a French co-efficient of not less than twelve, and preferably even greater, and a corresponding higher hardness value.

Larger Size Stones Predominating

The best and most lasting results are obtained if the sizes of the stone in this course vary from three-quarters inch to two and one-half inches, with the larger sizes predominating. This has been proven, even though it appears inconsistent, to use a two and one-half inch stone in a course two inches thick. Extreme care should be had in the laying and rolling of this course to have it uniform in its component sizes of stone and rolled to a uniform thickness. The rolling should be thorough, in order to reduce the voids and make the surface hard and smooth, although not as thorough as in the case of water-bound macadam roads.

After rolling, the bituminous material should be applied at a temperature of 250° to 300° F. with a mechanical distributor that will force the material on to the surface uniformly, such force being equivalent to that obtained under a pressure of thirty pounds or more to the square inch. The amount of bituminous material used per square yard in this application will vary from one and one-half gallons on a two-inch course to about two and one-half gallons on a three-inch surface. Great care must be taken in the distribution of the bitumen to prevent getting too much or too little material in spots or streaks, otherwise "bunches" or depressions, as the fault may cause, will soon develop.

After spreading the bitumen it should be lightly but completely covered with pea stone (1/2 in. stone) and thoroughly rolled, using a fifteen-ton roller, if available, if the stone is of hard quality, or a somewhat lighter roller if a poorer quality stone. Success will not be obtained if this course is not thoroughly rolled. A seal coat of the same quality of bitumen is then applied, using one-half gallon of bitumen to the square yard. This is again covered with pea stone and finished with the heavy roller.

Asphalt or Tar Bitumen

When the bitumen is applied the stone should not be wet but may be moist, and in all cases must be absolutely clean and free from dust. The bitumen used may be asphalt or tar product, and whether of asphalt or tar, the bitumen should be properly refined and prepared for use in this type of construction, its properties varying slightly with the climatic condition of the territory in which it is to be used. In northern climates like that in the New England States and lower Canada the best and most lasting results appear to be obtained by using an asphalt having a penetration of ninety to one hundred and ten, as determined by the standard method of testing adopted by the American Society for Testing Materials.

The United States Department of Agriculture has published a bulletin, (No. 691) giving specifications somewhat in detail for bituminous materials of differ-

ent kinds and for different uses. Reference is here made to that pamphlet for more details, but the writer believes from experience and observation that for penetration work in northern climates the asphaltic material should be a little heavier than that suggested in these specifications.

Where properly built under suitable climatic and traffic conditions, the bituminous macadam pavement is economical both in construction and maintenance. If a hole appears in the surface it should immediately be patched, using a mixture of small stones and hot asphalt or tar. If a general breaking of the top surface appears imminent, it should be given a seal coat of hot asphalt and pea stone before such breaking-up occurs.

Condensed Rules

A few condensed rules are here given for the prevention of unsatisfactory results with bituminous macadam:

Be sure that the drainage, sub-grade and foundations are suitable.

Have the surface of the bottom course even and without depressions before laying the top course.

Have the larger sizes of broken stone predominate in the top course.

Use dumping platforms or self-spreading wagons for spreading all broken stone.

Use a sufficiently hard bitumen for both penetration and seal coat, as a soft material permits the surface to soon become wavy.

Get all penetration work complete during the spring and summer months. If done in the late fall the penetration is not complete and the pavement is liable to become loose in the following winter.

Patch holes immediately if they appear in the surface.

If tar is used, apply a light seal coat at intervals of two or three years.

Discussion

In discussing Mr. Dean's paper, Mr. Sharples referred to internal compression and its prevention. The penetration method, he pointed out, would prevent this internal compression under heavy load. Some writers stated that the penetration method should be used with hard stone, but to his mind it was most important to use it where one had soft stone which would not give a good macadam in the ordinary way.

Professor Scott, of Queen's University, asked that Col. Sohier should give some light on the conditions under which it was economical to build roads with the penetration method. A penetration pavement, he said, when you have it built is only a near pavement.

When is the Penetration Method the Most Economical?

Col. Sohier replied that in some cases they had got fairly good results with the penetration method with stone that would not have stood up at all otherwise. He referred to one road which had been in use about eight years, upon which was used two gallons of a tar spread and which has stood up very well under traffic. Quite often the difference in cost of local stone, of poorer quality, as compared with imported stone, would make it less expensive to use the tar than to import the stone. He believed in the mixing method, however, as against the penetration method, providing a careful enough mix was made and sufficient care taken in the grading of the materials, though he had had

most excellent results in roads under heavy traffic by using stone rolled hard and then spraying in bitumen. He was not satisfied that anyone today had sufficient experience to be sure of the wearing qualities of a well-laid penetration pavement, but one of his best engineers believed that big stone well laid and finished with the penetration method was going to stand up better than the mixed method with small stone.

Mr. Sharples pointed out that in Massachusetts roads built with the penetration method using old macadam for the foundation, had cost about 40 or 50 cents a square yard, which was very much cheaper than any type of bituminous pavement. The cost of the latter ran from \$1.50 to \$1.75 per square yard. It therefore seemed to him that there was a definite field for the penetration type of pavement, and under certain conditions of traffic, such as in a small town, it filled a gap that was covered by no other type.

Town Planning Scheme for Suburban Montreal

THE South Shore Board of Trade covers that part of Chambly County, P. Q., immediately opposite and tributary to the city of Montreal. The bulk of its members is drawn from the towns of St. Lambert, Greenfield Park, Montreal South and Longueuil. During its short life it has proved itself a useful agency for good, and has recently undertaken the ambitious project of securing the adoption of a comprehensive town planning scheme for this part of suburban Montreal.

A committee of its own members, headed by Mr. Wayland Williams, spent a considerable portion of last year in considering how best to accomplish this object. As a result of its labors, this committee has now been succeeded by one composed of two aldermen from each of the four towns, one from the parish of St. Antoine de Longueuil and five members at large, with Mr. Williams remaining as chairman. The other members are Messrs. D. F. Kyle, Alex. Thurber, Omer Lecuyer, Edmond Hardy, J. E. Campbell, E. P. Gordon, S. J. Milligan, E. Backhoven, J. W. Oakley, E. Drinkwater, Assoc. Mem. Am. Soc. C. E., Jas. Ewing, M. E. I.C., W. J. Carmichael and A. Vincent, A.M.E.I.C., Mr. R. DeL. French, M.E.I.C., has been acting as secretary.

This committee has adopted the title of the "South Shore Joint Town Planning Board," and has held a number of meetings. All the town councils concerned have been interviewed, asked for their support, financial and otherwise, and a considerable amount of work has already been accomplished.

Messrs. Ewing, Lovelace and Tremblay are preparing a plan of the area to be included in the town-planning scheme, which will show all the physical features, both natural and artificial, including the public and semi-public buildings. With this plan, which is expected to be ready about Oct. 1st, as a basis, the Board intends to lay out a scheme of highways, industrial, business and residential areas, parks, sites for future public buildings, railway and harbor facilities, etc. This is the "town plan" and it will be submitted to the citizens for their criticism and discussion.

Where an acceptable town plan has been finally developed, the Board hopes to have an act ready for presentation to the Provincial Assembly, providing for

an authority to which will be entrusted the duty of putting the town plan into effect. Little can be done along these lines, however, in advance of the appeal to and approval by public opinion. The projects of the Board have been very favorably received so far by the municipal authorities, who have agreed to meet the cost of the plan, as the first step in the scheme.

The South Shore, like most of Montreal's suburbs, is a jumble of sub-divisions, promoted by various real estate operators, whose only desire has been to profit by their operations. As a result, the street system for example, is far from well arranged, and other features are in much the same state. With the rapid return of Canada to normal conditions, the extensive development schemes of the harbor commissioners of Montreal, the Canadian National Railways, and numerous industrial concerns, the present seems a most opportune time to consider the planning of this territory in such a way that the most good will accrue to the greatest number of its citizens.

Town planning means to many merely the beautifications of the community. It is really much more than this, and concerns itself with all that affects the physical well-being of the people. Towns have too long grown in a haphazard and, usually, extensive manner. The South Shore Joint Town Planning Board intends that the South Shore shall hereafter develop along rational and economical lines. Their project is of particular interest, as it is, so far as is known, the only example in Canada of a number of municipalities combining for their mutual advantage.

The Burning of Carbonaceous Clays

By J. Keele, Ottawa*

CARBON may occur in clays either as vegetable tissue, such as stems, roots and leaves, or as asphaltic and bituminous material or as hard coal substance. The first kind of carbon is often found in surface clays used for brick-making and generally causes no trouble in burning. The asphaltic carbon occurs mostly in shales and although the quantity present may be very small it is sufficient to give a dark color in the raw state, and to require special treatment in the burning process.

Certain beds of fine grained stoneware clay, which occur overlying the bituminous sand deposits in Northern Alberta, are impregnated with bitumen to such an extent that it is almost impossible to use them, as the fine texture of the clay does not permit the necessary free passage of air through the body to burn out the carbon, before vitrification sets in and prevents further oxidation.

Carbonaceous shales are frequently found in the coal measures of Pennsylvania, Ohio, and Illinois, where clayworkers have more or less difficulty in overcoming black coring and swelling or other defects which manifest themselves in the burning process. In some plants using these shales the fires have to be drawn and the kilns closed as soon as the carbon in the shales begins to burn, and firing is not resumed again until the carbon in the clay is exhausted.

Brickmakers throughout Canada have so far had little experience in burning carbonaceous clays as those generally used are the glacial surface clays which do not contain carbon. The shales used in the

*Before Canadian National Clay Products Association.

vicinity of Hamilton, Toronto, and Montreal, are free from carbon or contain so little that it does not cause trouble. Occasional evidences of swelling with black cores are found, especially in the red, dry pressed, shale bricks, but this appears to be due to a portion of the iron content of the shale not being thoroughly oxidized before the finishing temperature in the kilns is reached.

Powdered Coal or Sawdust Easily Burned Out

Powdered coal is often added to clay when making soft mud bricks, in order to assist the burning and make a more even distribution of heat in the scove kilns in which these bricks are burned. Sawdust is added to clay when making porous hollow building blocks, or terra cotta lumber. Carbon in these forms is easily burned out of the bodies in which they are used, as it is scattered in fairly coarse particles through the mass, and the finishing temperature of the burned wares is kept low, therefore oxidation can proceed throughout the whole process of burning and cooling. The powdered coal and sawdust have a certain fuel value as their presence in the clay undoubtedly assists in the burning process.

Experiments recently made by the writer for the Peerless Brick Company at Ottawa proved the necessity for careful preliminary investigation before using a new and untried material. The products hitherto made by this plant were soft mud brick, field drain tile and hollow wire-cut partition bricks, all burned in scove kilns, but the owners decided to enter the market for stiff mud, face brick, and hard burned fireproofing.

The clay being used was not suitable for these products, so it was proposed to utilize a supply of black shale, which occurs a short distance from the plant and to mix it with their clay. No previous use had been made of this material in the clay working industry, but it was the only shale available in the district. It is rather gritty and has only a low plasticity when ground and wet.

A certain amount of trouble was anticipated because the shale contains in addition to the carbon a small amount of iron pyrites, which must also be oxidized in burning. As long as there is any carbon present it appropriates all the oxygen in the air entering the brick, consequently the iron sulphide is not oxidized until all the carbon is expelled.

The shale was ground to pass a 10 mesh screen, and mixed with an equal weight of clay. Rustic face, solid, and plain, standard size, hollow brick were made by the small augur machine at the Mines Branch Laboratory. The burning was done in a down draft test kiln, fired with coal and coke. The first trials were burned with a steadily rising temperature at the rate of about 80 degrees Fahr. an hour for 24 hours to the finishing heat of 1850 degrees. The samples resulting from this trial had a hard black core with a spongy structure and were badly cracked and bloated.

Control of Burning Eliminated Cores and Bloating

What evidently happened in this case was that the carbonaceous matter in the shale was not completely burned out of the bricks before the surfaces had become so dense that the free passage of the gases through the body was no longer possible. The bloating was due to the ineffectual effort of the gases forming in the body of the brick to escape through the vitrified skin.

From the information gathered by the first test it

was decided to arrange the burning of the next lot of trials somewhat differently. The heat was raised at the same rate as before until a temperature of about 1550 degrees was reached. The kiln was held at this temperature for about four hours then closed and no firing was done for three hours more. The firing was then resumed and the temperature raised at the regular rate until the finish, the total time occupied in burning was about 30 hours. The result of the second test was that the bricks were intact and the black cores completely eliminated by this method of burning.

The carbon present in this shale cannot be said to have any fuel value as the longer time taken in the burning process offsets any advantage in the heat arising from its combustion. The carbon may rather be considered as a detriment in shales with a low vitrification point, such as the Ottawa shale has, as there is always the danger of vitrification beginning before the carbon is completely eliminated, a condition which is sure to result in bloated brick.

When is Carbon Completely Burned Out?

There are two well-known methods of determining when the carbon in bricks is completely burned out, and when it is safe to proceed to a rise in temperature. One method is to begin drawing trial bricks from the kiln through an opening in the wicket when the burner decides that the proper temperature has been reached. By drawing bricks at certain intervals and breaking them it can be seen that the black core gradually grows smaller and finally disappears. When the last trace of black is gone it is then safe to raise the temperature of the kiln. Another guide is the use of a pyrometer outfit attached to the kiln. By this means the burner watches the indicator of his pyrometer dial, and by careful firing does not exceed the proper temperature until the danger period is passed, the length of time of holding the fires at a certain temperature having been decided beforehand by draw trials.

Coal ashes either from anthracite or bituminous coal can be ground and used as a grog in the brick clay of eastern Ontario or Quebec for the purpose of making hollow blocks. The advantage of using ashes is that it may contain a little unburnt fuel and it also assists materially in fast drying of the wares and in reduction of shrinkage.

The clay in the Ottawa and St. Lawrence Valley is, as a rule, very sticky and plastic, and will hold about an equal weight of ground coal ash and still make a workable mixture. A dry pan or some method of reducing the ashes to the proper size would have to be added to the plant.

Proposed Schedule of Salaries

Chicago Chapter A.A.E. Determines Fair Remuneration for a Wide Range of Engineering Positions in Varied Lines of Work

AS an indication of the extent to which one engineering society, at least, has attempted to determine a fair remuneration for engineering services, we publish the schedule below, stating a comprehensive list of salaries for a wide range of engineering positions in varied lines of work. This has been adopted by the Chicago Chapter of the American Association of Engineers, and has been referred to the association with the suggestion that it

be utilized in a nation-wide study of the subject, for the formulation of a general schedule of salaries. The present schedule covers architectural, highway, municipal, state and electric-railway work (steam-railway work has been covered by the parent association); county and rural positions, large engineering organizations, public-utility boards and corporations, telephone work and expert service.

It is explained that the salaries recommended are for positions which provide continuous employment and offer advancement in rank and pay as a reward for efficient service. For seasonal employment, where the work continues from year to year, but is interrupted by idle seasons, it is suggested that the pay should be such as to amount to about half pay during the period of enforced idleness. Thus, for an eight-month season, where the schedule rate is \$2400 per year, the pay should be \$250 per month. For temporary positions, where there is no developing future, the pay should be 50 per cent. above the schedule, in order to provide greater incentive for good work and repay the employee for changing location.

Proposed Schedule of Salaries Adopted by the Chicago Chapter

Architectural Engineers.—The committee states that to those who are not architects the rates seem to be low, but the schedule is thought to be reasonably fair to employer and employee. There appear to be no uniform rules as to education or training required for the positions.

Architects in charge of office	\$5000—\$8000
Designing draftsman	4000—5000
Construction design draftsman	4000—5000
Outside superintendent	4000—5000
Senior draftsman	2400—3000
Junior draftsman	1500—2100
Student draftsman	900—1200

Road Engineers.—This schedule is for a state having 60,000 to 100,000 miles of roads and in which the highway department spends not less than \$5,000,000 annually.

Chief highway engineer	\$8,000—\$10,000
Road engineer	5,000—7,000
Maintenance engineer	4,500—6,000
Bridge engineer	4,500—6,000
Engineer of tests	3,000—4,000
Division engineer (7,000 to 10,000 miles)	3,600—5,000
Assistant engineer	2,700—3,600
Resident engineer	2,700—3,600
Chief designing engineer	3,000—4,000
Designing engineer	2,700—3,300
Junior engineer, class A	2,100—2,700
Junior engineer, class B	1,500—1,800
Inspector*	1,320—1,800

Municipal Engineers.—The proposed schedules for municipal engineers are as follows:

City Engineer, annual work, \$5,000,000	\$12,000—\$15,000
City engineer: annual work, \$2,500,000	8,000—10,000
City engineer: annual work, \$1,000,000	6,000—7,500
City engineer: annual work, \$500,000	4,000—5,000
Department engineer	5,000—7,500
Division engineer	4,000—7,500
Assistant engineer	3,000—3,600
Instrumentman (preferably techn'l graduate)	2,000—2,400
Rodman (high-school, 2nd grade)	1,080—1,500
Inspector	1,380—1,800
Architect	3,000—5,000
Designing engineer (technical graduate, 10 years' experience)	4,000—6,000
Designer (technical graduate, 5 years' experience)	3,300—4,400
Detailer (technical graduate preferably)	2,000—3,000
Tracer (technical high school)	1,200—1,800
Draftsman, architectural	1,800—3,000
Draftsman, map or topographic	1,800—2,400
Draftsman, structural	1,800—2,400

Electric Railway Engineers.—For the case of railways with 60 miles of track:

Chief engineer (track, structures and transmission lines)	\$ 3,600—\$ 4,800
Assistant engineer (field)	2,400—3,000
Roadmaster (preferably technical education)	2,400—3,000
Mechanical-electrical engineer	4,200—5,400
Office engineer (mechanical-electrical)	2,400—3,000

For railways with 200 miles of track:

Chief engineer	\$ 4,000—\$ 5,400
Assistant engineer	2,400—3,000
Roadmaster	2,400—3,600
Electrical-mechanical engineer	4,500—6,000
Assistant engineer (electrical-mechanical)	2,400—3,000

County Surveyor.—As a rule this is not a salaried position, but it is of such importance that a sound policy would provide an office and pay for keeping open a stated number of days per week, depending upon the wealth and population of the county. The pay per day for land surveying should be adjusted to correspond with the value of the land, as follows, since the surveyor is responsible and may be sued for damages due to erroneous work:

	Surveyor	Assistant
Land up to \$25 per acre	\$ 12.50	\$3.75
Land at \$25 to \$200 per acre	18.00	5.00
Land over \$200 per acre	20.00	5.00

A similar rate should be paid for work of the intermittent class or for drainage, levee or road work, with pay for a specific number of days per month to cover consultation and correspondence.

Deputy county surveyor	\$ 3,000—\$ 4,200
Employees on drafting and instrument work	2,100—2,700

County Engineer.—Good roads organization in counties spending at least \$500,000 annually on highway work:

County highway engineer	\$ 4,200
Assistant engineer	3,000
Junior engineer, class A	2,400
Junior engineering, class B	1,800
Inspector (for qualifications see under "Road Engineers")	1,500

A similar organization is desirable for levee and drainage work, but must adapt itself to wider variation than the road work. Such adaptations can be made according to the particular work in hand.

State Public Utility Board.—For the engineering department of a board in a state having a population of 5,000,000:

Chief engineer	\$12,000—\$15,000
Assistant chief engineer	9,000—10,000
Chief of railroad division	8,000—9,000
Chief of gas division	6,000—7,500
Chief of telephone division	6,000—7,500
Chief of waterworks division	6,000—7,500
Chief of service division	6,000—7,500
Assistant engineer, grade 1	3,600—4,800
Assistant engineer, grade 2	3,000—3,300
Assistant engineer, grade 3	2,400—2,700
Assistant engineer, grade 4	1,800—2,100

Announcement is made by The Barber Asphalt Paving Company, Philadelphia, that following the promotion of Mr. Charles W. Bayliss, formerly manager of the street and road department, to vice-president in charge of sales, the following changes in organization became effective June 1st, 1919: Mr. J. E. Morris, manager street and road department, Philadelphia, Pa.; Mr. H. M. Stafford will succeed Mr. J. E. Morris, as assistant manager, in charge of the eastern district, with headquarters at Philadelphia; Mr. F. F. Massey is promoted to succeed Mr. Stafford as assistant manager, in charge of the southwestern district, with headquarters at Memphis, Tenn.; Mr. G. R. March is promoted to succeed Mr. T. H. Morris, as sales manager of the Iroquois Department.

Accounting for the General Contractor

No Two Contractors Have Same Method—Standard Scheme Advocated to Give Contractors Better Status and Financial Soundness

By L. A. Weatherwax*

I VENTURE to say that no two contractors have the same method of accounting; one man has a very pretty double entry system that nobody can understand except the man who keeps the books, while the next man has his books on the back of an envelope in his inside pocket; the third man doesn't keep books at all. This wide divergence in the matter of accounting, together with a similar lack of co-ordination in the matter of estimating and cost-keeping, is responsible, in great measure, for the wide divergence noted at almost every opening of bids. It is partially responsible for the feeling of distrust engendered in the minds of the banker and bondsman—the very people without whom we cannot do business, be it large or small—when we go to them for a legitimate business loan or require a bond.

A wide divergence in the method or rather lack of method in accounting, estimating and cost-keeping is again responsible for the feeling in the mind of the general public that the extremely low bid is the correct bid and all the other bidders are robbers. We must also combat the idea in the public mind that was originally conceived in the mind of the cartoonist, that of the contractor with his pockets stuffed full of juicy contracts, a wide expanse of vest, big, fat, jolly, rolling in opulence. We are distrusted by everybody. Our banker thinks we are gambling. Our bondsman thinks we are padding our assets, and the architect and owner think we are combined to take excessive profits from our work, when, as a general rule, when we go to our banker for a loan, it is in most cases a legitimate requirement of our business.

Develop a Standard Scheme

For our own good as well as a means of raising us in the estimation of our fellow citizens let us devise some general scheme of accounting which will at once be capable of expansion to care for the needs of the largest operator as well as for the man whose limited capital necessitates the accepting of smaller contracts. With two or three exceptions we are all operating on a capital invested of not to exceed \$100,000, and it should not be a serious matter to devise some standard guide by which we could all work, varying details to suit our individual requirements, and the time is not far distant when either we shall have to take steps towards some such standard form of accounting or our government will do it for us.

Do you know that the lumbermen spent some hundreds of thousands of dollars in an effort to standardize their accounting and cost records so that they could "account" to the government for every item entering into the manufacture of lumber of all grades, and thus convince the government that they were not profiteering. You have noted that lumber prices have been pretty much the same as between different mills. It is not because they have gotten together and said that such and such a price shall be charged, but primarily because they have a standard system of cost-keeping and accounting which shows them that it

is costing them approximately the same to manufacture and market their product—allowing of course for rail facilities, stock on hand, etc. They have found that some such system was absolutely necessary in order that they might put themselves right with the public; and some such system is just as urgently needed by the contractor for his business.

Little Idea of Accounting

Then again we are harassed periodically by the state in the collection and reporting of contributions to the industrial insurance and medical aid funds, while in states having no such laws we are forced to carry liability insurance, our payrolls subject at stated intervals to audit by state or private officials. A five minutes' talk with one of the auditors for the state industrial insurance commission would convince you that the contractor, generally speaking, has very little idea of accounting. The very provisions of the laws as regards the percentage of contribution are supposedly based upon the percentage of accident in the different trades employed in the construction of a building, consequently we are required to make at least some segregation of our payrolls, at least as between laborers, carpenters, roofers, painters, etc., each of whom have different accident ratios, consequently different premium rates per dollar.

Some of us have a daily report system, very complete and also very costly, kept by the foreman who, in the rush on the job, generally forgets all about the report until night, then puts down something to satisfy the office—sometimes correct, but oftentimes not. On large operations, justifying the employment of time clerk and cost clerk combined, the tendency is to go into too much detail and swamp the "accounting" office with a mass of detail and costs which are carefully worked up and then forgotten.

Periodically we are asked by Dun or Bradstreet to furnish them with a statement of our assets and liabilities, generally accompanying the request with one of their printed forms which those of you who have had that experience will know is adapted to the ordinary manufacturer, merchant—any business but that of the general contractor. We wrestle with their form and finally give them something to satisfy them, either on their form or one we have pounded out in haste for ourselves. The result is generally not very illuminating either to them or to us, and leads us into a false sense of financial values.

Dealing with the Banks

The same is true of many banks. When a customer goes to his banker for a loan, unless he has adequate collateral, the first thing requested of him is a prerequisite to any consideration of his application for accommodation is a financial statement showing in tabulated form his net worth. All of us use or should use our bank as our financial adviser and counsellor, and in the line of credit allowed us by our bank we find an answer to what our bank thinks of us as financial risks. We all know that banks generally are not overly anxious for the contractor's business for several reasons. The average contractor by the very

*Of Henrickson & Co., Inc., Contractors, Seattle, before Northwest Master Builders' Convention.

nature of his business cannot keep large average balances. He makes relatively few deposits and writes hundreds of checks, making work for the bank's bookkeepers. On top of this the very nature of his business again tends toward unconscious inflation of his net worth, especially where several operations dovetail one into the other. We must make our banker our confidant, must instill a feeling of confidence in him, and, one of the first ways of establishing such relations is by means of a monthly balance sheet, using care to see that for comparative purposes it is always on the same form. For the betterment of the profession as a whole, why is it not logical to devise a standard form of balance sheet for the use of all contractors? Such a form could easily be prepared when the monthly trial balance is taken, and should the contractors as a class voluntarily on the first of each month mail to their bank and to their bondsman a copy of their balance sheet, it would go a long way towards procuring for us as a whole the good will and confidence of the very people we must conciliate, to say nothing of the great good to our credit among supply houses who universally use the services of Dun and Bradstreet in an effort to keep a line on the financial responsibility of the general contractor.

Let us devise a standard payroll sheet, preferably loose leaf, which will provide for medical aid and insurance tabulations as well as private cost records, bond reconcilements, etc. Let us devise a check register for handling our general account, which will enable us to segregate our payments to the different operations without the necessity of first running all accounts through a bulky journal. Let us devise a uniform balance sheet to be used for the information of those entitled to have such information. Then let us all use them, go to our bank and our bondsmen and say: Hereafter you will receive a copy of our balance sheet each month on this form that you may know as well as we just what our business is doing.

Financially Shaky

I cannot hammer home too strongly the fact that as a class we are considered shaky financially. If we are to make these people know that we are substantial we must take steps to convince them that we are going to do business along proper lines, and what better way than to be able to say that we, too, have had our "house cleaning," that we, too, by our very determination, are going to demand that we be considered as business men, and then back up our assertion with vital information in the proper place. In this way will we pave the way for better business, better credit and better associations with those upon whom we are dependent.

Workmen's Compensation Report

THE report for the fourth year's operation of the Workmen's Compensation Act, which is now printed, contains much interesting information concerning industry, workmen, and accidents in the province.

During the year \$3,514,648.47 was awarded for compensation, or \$11.600 a day, and \$369,346.37 for medical aid, or \$1,219 a day, the number of cheques issued per day being 248 for compensation and 139 for medical aid. Payment was made for 40,930 accidents, 382 of these being death cases, 2,549 causing some degree of permanent disability, 25,446 causing only temporary disability, and 12,553 involving only medical aid.

It is estimated that over 500,000 workmen are covered by the provisions of the Act.

As the disability in serious accidents often continues into and sometimes beyond the following year, complete statistics can only be given for the prior year. These show that about 75 per cent. of the injured workmen were British subjects and 25 per cent. foreign, 6½ per cent. being Austrians, 6 per cent. Italians, 5½ per cent. Russians, and 2½ per cent. citizens of the United States.

The average weekly wage of injured workmen was \$19.06, and the average age 34.07 years. The total time loss from accidents during the year was 565,526 days; the average length of temporary disability was 21 days.

Machinery caused about 32 per cent. of all the accidents; the handling or moving of objects, 28 per cent.; and falls of the workmen, 10 per cent. The most prolific individual causes were saws which caused 892 accidents; lathes, 891; presses, 813; hoisting apparatus, 785; abrasive wheels, 781; belts, pulleys, chains and sprockets, 390, of which 17 were fatal; planers, jointers, and edgers, 260; shapers, moulders, and headers, 121; shafting, couplings, and set screws, 75, of which 6 were fatal. Falls from vehicles caused 260; collapse of support, 276. Hot and inflammable substances caused 1,018 accidents; falling objects caused 1,256; and runaway animals, 98.

Statistics show that from 40 to 60 per cent. of what is paid by employers for private insurance elsewhere is consumed in expenses and profits, and less than 25 per cent. of what the employer paid under the old employers' liability system actually reached the workman or his dependents, the rest being absorbed in legal and other expenses.

Comparisons of rates of assessment are significant. The steel works rate, for instance, under the collective liability system, is in Ontario \$1.70, Nova Scotia \$1.90, and Ohio \$1.75, as compared with a rate under the private or mixed system of \$3.74 in Michigan, and \$5.02 in New York. For mason work the rates are: Ontario \$1.50, Nova Scotia \$2, Ohio \$2.85, Michigan \$5.41, and New York \$8.74. In Michigan the benefits are little more than half what they are in Ontario.

Cost Plus Fixed Fee on a Sliding Scale Proves Cheaper

THE Essex Border Utilities Commission, having in charge the disposal of the sewerage for the Essex Border District, had plans and contracts prepared for sections of the intercepting sewer and bids for the construction work were received from contractors in July, 1918.

The figures received were considered too high and on recommendation of the engineer the work was re-advertised, to be paid for on the basis of cost plus a fixed fee on a sliding scale. Construction work was started immediately upon the letting of the contract, and continued until the practical completion of the work.

Owing to the war conditions existing at the start of the work, wages and the prices of material were necessarily high, but it was interesting to note the increased rate of progress each week as the work became more thoroughly organized. It is also interesting to note that on the original basis of a lump sum contract 3 bids were received, but that upon the announcement that the work would be done at a cost plus basis ten different contracting firms submitted

completed figures and several others sent in alternative quotations.

The figures quoted at the first letting of July 1st, 1918, were as follows: \$172,400, \$165,400, and \$163,600. The estimated costs submitted by bidders on August 22, 1918, after the re-advertising, which includes the contractor's profit of \$12,000, were as follows \$181,200, \$173,200, \$167,300, \$148,900, \$147,100, \$143,200, \$131,800; \$131,200, \$130,200, and \$120,600.

The work is now practically completed at a cost to the Commission of \$124,200. This indicates a saving of \$41,200 over the lowest bid under the lump sum contract method. Merlo, Merlo & Ray Ltd. of Walkerville, Ont., were the contractors, and the work was done under the direction of Morris Knowles Limited, engineers for the Essex Border Utilities Commission.

The Relationship Between the Construction Industry and American Business as a Whole

THE following interesting data have been collected by Mr. W. T. Rossiter, President of the Ohio Builders' Supply Association and Chairman of the Own Your Own Home Committee of the National Federation of Construction Industries, in connection with his work with the Industrial Board, showing the relationship between the construction industry and business as a whole. The industry is seen to be the largest in the United States, not only from the standpoint of materials produced and the tonnage furnished to the railroads, but from the great number of persons employed.

The following figures are computed from the 1910 reports of the Bureau of Census, which includes a tabulation of male occupations for the year 1910, in which 30,091,564 men are reported as employed. They are as follows:

Agricultural, Forestry and Animal .. .	10,851,792
Extraction Minerals, Oil and Gas .. .	963,730
Transportation .. .	2,531,075
Retail Dealers .. .	1,127,926
Professional service .. .	929,684
Domestic and Personal Service .. .	1,241,328
Clerical Occupations .. .	1,143,829
Building Trades .. .	4,269,466
Unclassified .. .	7,032,824

Total employed males .. . 30,091,564

Employment in Construction Industries

It will be noted that those employed in the building trade number 4,269,466. To this number must be added 25 per cent. of the total employed by the railroads of the United States, since, as shown below, roughly, 25 per cent. of the total tonnage moved by the railroads consists of construction material. It will be seen that transportation employs, roughly, 2,500,000 men; 25 per cent. of that number is approximately 630,000 additional men who are employed because of the construction industry. Further, statements by the Fuel Administration and other authorities indicate that approximately 30,000,000 tons of coal are consumed annually in the production of lime, cement, brick, clay and gypsum products. It would be necessary, in order to obtain the total number of men employed because of the construction industry, to take a proportion of those employed in forestry, in the extraction of minerals, retail dealers, in professional services, in clerical occupations and some listed as unclassified, such as wholesale dealers, etc.

The following comparative figures on railroad tonnage are taken from the Interstate Commerce Commission report for one year ending June 30, 1916:

Agriculture .. .	112,460,531 tons
Products of Animals .. .	29,155,548 "
Coal, Coke or Ore .. .	548,651,092 "
Building materials (no metals):	
Cement, Brick and Lime 43,165,-	
161; Stone, Sand, etc., 101,009,-	
164; Lumber, 63,395,028 .. .	207,569,353 "
Manufactured Articles .. .	136,246,713 "
Miscellaneous .. .	115,759,060 "
	1,149,842,297 "

Materials of Construction

The following figures show the relationships between values of the principal materials used in the construction industry. These figures were obtained from reports received by the U. S. Geological Survey for the year 1916 and are in terms of the value of the finished product at the plant:

Stone .. .	\$79,041,699.00
Clay Products (finished) .. .	207,260,001.00
Clay Products (raw) .. .	5,751,774.00
Portland Cement .. .	104,689,090.00
Lime .. .	18,618,816.00
Sand Lime Brick .. .	1,474,073.00
Slate .. .	5,338,837.00
Gypsum .. .	7,959,032.00
Sand and Gravel .. .	27,852,198.00
Lumber .. .	609,847,085.00
Structural Steel .. .	227,247,300.00
Nails .. .	53,720,000.00

\$1,348,799,905.00

The total annual expenditure in connection with construction in the United States in normal times is in the neighborhood of \$3,000,000,000.00.

In calculating the cost of labor entering into construction, the percentages of the several materials employed in typical construction were taken, together with the percentage of the direct labor involved in producing the material as reported by the several industries. In the final compilation, without including labor employed in transportation, it was found that about 80 per cent. of the entire cost of producing the material and assembling it in finished construction is labor.

It is evident that the cost of construction cannot be expected to decline unless there is a corresponding decrease in wage rates, which should not occur if the American standard of living would thereby be lowered.

Mr. Rossiter concludes his report with the following pertinent observation:

"Technically, if we base all our figures on a 70 per cent. normal basis and assume that half of the 70 per cent. of the entire construction industry is now in operation, the country would still be suffering from the following losses. Freight tonnage, 10,000 cars per day; financial loss, \$5,000.00 per day; unemployment, (direct) 1,500,000 men; while, if the industry were operating on a 100 per cent. basis, it would mean that over 2,000,000 additional men (direct labor) would be required."

At the annual meeting of the Hamilton branch of the Engineering Institute of Canada the following officers were elected for the ensuing year: Honorary president, Robert Hobson; chairman, R. K. Palmer; vice-chairman, H. U. Hart; secretary-treasurer, C. F. Whitton; counsellors for two years, H. B. Dwight and F. B. Paulin; counsellors for one year, past chairman E. H. Gray, E. H. Darling and J. A. McFarlane.

The Design of Steel Mill Buildings

Practical Considerations Entering into the Design of Such Structures—Commercial Features Which Should Not be Ignored

THE design of steel mill buildings may be considered in two ways, first, in what may be called theoretical design and second, the practical design. A theoretical design is one in which the calculation of stresses and the proportioning of members according to mathematical rules are the dominant, if not exclusive, factors. A practical design introduces many features learned only by experience. The one is not necessarily contrary to the other. It is usually taken for granted that a building designed by a mere theorist will be unsatisfactory, but many a building designed by a so-called "practical" man has given trouble. Crane girders have had to be strengthened against lateral vibration, jib cranes have failed, trusses have unduly deflected, bracing has been inefficient, all because the "designer" had insufficient theoretical knowledge of the theory stresses. In a paper presented before the Buffalo Engineering Society, Mr. R. Fleming of the American Bridge Co. points out some of the practical considerations that enter into the design of these structures. An abstract of his paper follows:

Proposed Uses of Industrial Building Determine its Design

The design of a proposed industrial building should be determined by the uses to which it is to be put. Preliminary data should be obtained. Studies should be made of other buildings in which similar work is being done. Industrial processes should be understood and proper provision made for carrying them on efficiently and economically. Too much stress cannot be laid upon these points. Many a building has been handicapped for all time by too many interior columns. Especially is this true of steel mills. The additional first cost of a long truss or girder would have been paid for two or three times a year had no column interfered with handling material about a forge or press. In one machine shop a light traveling crane would often be a labor saving device but it cannot be installed because of insufficient head room. In another building an excessive vibration is found. All of these conditions may have come because the designer did not sufficiently understand the industrial processes to be carried on in his building.

Another necessity, or rather a wonderful convenience, in a building is adaptability for extension. The cost of making full trusses at the ends is but trifling compared to the convenience they will be if the building should ever be made longer. Industrial processes are constantly changing. Heavier machines are being used. Even if a gallery floor of a machine shop is strong enough for present needs, will it be for the needs of five years hence? If a business succeeds at all it will grow. A lack or a false idea of economy at the start has often been atoned for later at great cost in making alteration or in loss of business.

Days of Specialization

If the building is to be used for manufacturing purposes, a lay-out of the machinery should be obtained

from the mechanical engineer. This is necessary to locate columns to the best advantage. In these days of specialization we have also the heating and ventilating engineer, the illuminating engineer, the sanitary engineer, and others. When the steel work is but a comparatively minor part of the structure the work of the architect precedes that of the structural engineer. Where the steel work predominates, the structural engineer should take the lead. In the design of mill buildings he is often both engineer and architect.

A proposed building may be within the limits of a city having a code of building laws. Unfortunately, few building codes are written with the steel mill building in mind. As far as steel requirements are concerned the place of public assembly and the many-storied building are chiefly in evidence. The result is that the designer of a steel mill building is obliged to grope his way through requirements for other kinds of structures or take chances and cut away from the municipal code altogether.

Lighting

In late years the question of proper lighting and its economic value has been widely discussed. In an average 24-hour day we have $11\frac{3}{4}$ hours of darkness, $4\frac{1}{2}$ hours of cloudy or foggy atmosphere and $7\frac{3}{4}$ hours of sunshine. Hence manufacturing plants must operate for part of the time by artificial light. We now have the illuminating engineer to deal with this feature but it belongs to the structural engineer to make the most of the natural or day light. This is a problem of the quality of light admitted as well as the quantity, a problem of distribution as well as extent of sash area. Since the continuous steel sash has been developed to its present state as high as 75 to 90 per cent, of the siding of a building has been glazed. But too much light may create a glare and be as harmful as too little. In a 1-story building in Pennsylvania the workmen are obliged at times to wear sunshades. The windows or sash should be low if there are benches along the wall or if light should be needed near the sides. To light the central portion of the building they should be as high as possible or directly under the eave strut. A combination that has given excellent satisfaction is a belt of continuous sash directly under the eave extending all round the building and the balance of side and end area filled with belts or brick, tile, concrete or sheet metal and continuous sash. Or, windows of large size can be set in the side covering. Skylights in the roof are expensive, are liable to breakage, are a frequent cause of leaks and when covered with snow do not admit light.

For the proper proportion of glass surface to the side and roof areas of a building no definite rules can be given. In general it may be stated that the proportion in the sides should be large—say 50 or 60 per cent, and in the roof small—not over 10 per cent. For wide areas what is known as saw-tooth construction is being extensively used. It is a series of trusses with one side vertical or slightly inclined and glazed, and the other side covered with roofing. The glazed side should

face the north. A diffused light thus illuminates the floor below without casting shadows. Other forms of construction have given excellent satisfaction.

Ventilation

This is often secured by having in the sides of the building what is known as "ventilating sash," or a whole row of sash may be "top hung." Windows opening in the usual way are often used, or the sash may be balanced, saving the expense of counterweights. A monitor is often built on the ridge of the roof with sides of sheet metal, swinging shutters or fixed louvers. With the sides of swinging or sliding sash both ventilation and light are secured. Tubular ventilators of which several makes are on the market, placed at intervals along the ridge of a roof are effective in creating an upward current of outgoing air. About 1 sq. ft. of ventilator area to from 200 to 400 sq. ft. of floor area should be allowed.

Heating

A common system of heating is that of forcing fresh air over heated pipes in a cast iron case and from thence distributing through conductors into various parts of the building. Other system of heating are in use, but it is seldom that questions of heating are decided by the structural engineer.

Plans and Specifications

"To be strictly executed in accordance with the plans and specifications," reads almost every building contract. The plans should embody the design of the building. If drawings are only wanted to give the prospective purchaser an idea of his building, a great deal of information can be omitted that is necessary on the finished design. It is a wise plan, however, to make even the preliminary drawings as full and complete as time and circumstances will permit. Clearness and accuracy should be essential features of the plans. Three engineering rules often neglected are: Make provision for special loadings. Be sure that the building is well braced. Carry all wind stresses to the ground. The neglect of these rules has proved disastrous to many structures.

The specifications should be clear, accurate, concise, consistent, complete and fair. Explanations of their meaning should not be necessary. They should not be so long as to be unwieldy nor should anything essential be omitted. Great care should be taken that the scope of the work to be furnished is clearly defined. It should be definitely stated whether stacks, tanks, elevator framing, stairs and similar items are included. Any special features should be emphasized. "Blanket" clauses and those embodying unusual requirements should be avoided.

In the examination of more than a thousand specifications for structural steel buildings some were found to be so very general in their provision that they lacked definiteness, others entered into detail to such an extent as to embarrass the contractor. In some the writers had depended upon others and did not use good judgment in copying. Some were ambiguous, and others were unfair. A specification is unfair whenever it throws the burden belonging to one party upon some other party. Almost invariably the steel contractor is the one who is called upon to shoulder what does not belong to him.

The Commercial Feature of Structural Engineering

Both engineer and purchaser should know that there are commercial features in the design of steel

structures which should not be ignored. For instance a design may call for sections that are seldom rolled. This means delay in delivery from the rolling mill and may result in the whole structure being held up indefinitely for one or two special sections. The fewer the sizes used, the more duplication there is in working drawings and in fabrication. Again, the designer should consider the ease with which rivets can be driven. A column made of two channels with toes turned in and laced is a hard column to rivet. Questions of transportation and erection should be given attention. By shipping trusses "knocked down" more weight can be loaded on a car, thus lessening freight but requiring that more assembling and riveting be done in the field. If shipped in large sections the cost of transportation and handling may be greater but that of erection will probably be cheaper. Care should be taken that the length or weight of pieces do not exceed the capacity of the erection equipment and that field connections can be easily made. These and similar questions must not be ignored.

Lastly, it is difficult to unduly emphasize the importance of good detailing. Close fits are expensive. Eccentric rivet connections producing secondary stresses should be avoided as far as possible. In fact, poor details can mar an excellent design.

Revival in Construction Will Follow Publicity Measures

THOSE Montreal contractors who insisted that prices would not come down this season, and that now is the time to build, have been fully justified. While it is true that in some directions prices have receded, the tendency of labor—the main item in building costs—is to advance. In almost every direction workers are asking for more pay, and with the consequent industrial unrest, estimating on jobs is a more than usual risky business. The contractors of Montreal and of every other large city might copy the example of Detroit, where the brick makers convened a round table conference with the architects, lumbermen, contractors, supply men, and others interested in building, and went thoroughly into the question of costs. The aid of the newspapers was solicited, resulting in wide publicity, showing the public that there was no possibility of prices receding. Build now was the keynote of the conference. The public were convinced of the soundness of the arguments, and a pronounced revival in construction followed.

Construction in Montreal is, on the whole, better than last season. Much of the work, however, is of a small character. There is some work of importance in sight, including a new Y.W.C.A.; a large garage in Westmount; Jewish synagogue; an extensive addition to the Tetrault shoe factory in Maisonneuve; hippodrome, Montreal; extension to Loyola College; extension of Notre Dame Hospital; Y.M.C.A. at Point St. Charles or Verdun; new abattoir at Point St. Charles; a large movie house; new Crown Trust Co's. office building; and two cold storage warehouses, one of which is on federal government account. Several additions to factories are in course of erection, and two large apartment houses are also being constructed.

Work in the province of Quebec is also picking up. Among the jobs recently given out or contemplated are: an addition to a shoe factory, Quebec; cheese factory, Shawinigan Falls; addition to the Laurentide

plant, Grand Mere; schools at Cap de la Madeleine and Quebec; technical school, Three Rivers; convent, Three Rivers; churches at Rigaud, Chicoutimi, St. Joseph de Kamouraska and Ste. Anne de Monts; office building, Shawinigan Falls; and cold storage warehouse and office, Three Rivers. Besides this work, a large number of contracts for concrete or steel bridges have been either let or are in course of being so, while a very considerable amount of road work is being done.

Pushing of Public Works Advocated to Restore General Business Activity

THE National Federation of Construction Industries, in a recent news letter, advocates as one of the most important steps in the restoration of general business activity the provision that the National Government shall concentrate in the immediate future its programme of the construction of public works, which would normally be extended over the next several years, in order to effect a quick, general resumption of business, which would follow the stimulus given by large government activities.

The Federation also presents a national construction programme, indicating its position relative to the transition of the American construction business from a war to a peace basis. The magnitude of the construction industry and the diversity and wide geographical distribution of the interests concerned gives the construction industry a pivotal position in its influence upon the return of general business to normal conditions. The federation therefore advocates that public work already authorized should be proceeded with, and that, if necessary to complete such work, additional appropriation should be made for that purpose.

Uncertainty Cause of Inactivity

The news letter states: "Since the signing of the armistice there has been a marked halt in production and general indecision in business. The unsound conditions usually preceding a business depression do not exist. It is the belief of many leading business men that uncertainty as to the stability of present costs of labor and material is the chief cause of business inactivity.

"Investigations by government experts and competent private agencies indicate that when business does resume it must be on the basis of present prices. In fact, the operation of the law of supply and demand, necessarily adjourned during the war, is slowly resuming, affecting in itself a stabilization of prices on the present level. This movement is, however, so slow that, unless accelerated, the country cannot hope for an early restoration of complete business confidence. We have the alternatives of groping our way slowly to normal conditions, with an attendant extended dissipation of resources, unemployment and social unrest, or by concerted action through the agencies of the government, of resuming business immediately at present cost levels, leaving future values to be determined wholly by supply and demand.

Prices Have Advanced

"During the last six months the buyers of the country have made an unexampled attack upon prices by their refusal to purchase, and yet prices have not declined in any significant amount; and in the construction industry, which was largely curtailed during the war, many prices have advanced.

"After a careful canvass of opinion, the directors

of this federation—potentially representing one-third of the industries of the United States, including producers, distributors, contractors, architects, engineers and all other branches of the industry, which normally employs more labor than any other industry in America—believe that no concerted movement of private interests can quickly and independently re-establish business confidence, and that the business of the country will be fully resumed only after a long period of loss and disquiet, unless the national government takes action to correct the condition.

"This matter has been discussed with some of the most conservative and careful business men of the country, and without exception they believe that a rapid return to normal business activity can be realized only through an example set by the government by its becoming the first large purchaser of commodities at current prices."

Method of Cleaning Sand Filters at Brookline, Mass.

A SPECIAL study was made by the Water Department of Brookline, Mass., to determine the best way of operating its filtration plant.

This plant was placed in service in 1917, and it became apparent quite early that the best results could not be obtained by operating in exactly the same manner that similar filters were operated. The presence of more or less organic matter and other substances, in addition to the iron and manganese, requires different treatment in each case, and no two waters are alike in these respects. In some instances, if the raw water is aerated too much, more of the iron is liable to slip through the sand, and if sufficient oxygen is not absorbed by aeration, equally unfavorable results will occur. In order to solve these many problems which come up, tests of the effluent were made twice each day, and tabulated, and by this means the results of the different experiments could be studied, and the necessary changes in operation made.

The efficiency of the filter, states the report of the Department for 1918, is now as complete as could be reasonably expected. The following methods were found most desirable for removing the accumulations of iron and manganese, etc., from the tricklers and filters.

The tricklers are cleaned by flushing as follows: First, the outlet and inlet gates are closed, and all the spraying caps removed. Then the flushing gates in opposite sides of tricklers are opened, which allows the water to run to waste. The second step is to turn the combined flow of all the tricklers through this one, which so increases the amount of water passing through the coke, that in the course of one-half to three-quarters of an hour, a larger part of the various accumulations is removed. Each trickler is flushed every 10 or 15 days.

The sand filters are cleaned in this way. After the water is drawn from the bed to be cleaned, about ½ in. of sand with the iron deposit is carefully scraped off, and thrown out by a water ejector directly into a washer. As fast as the sand is washed, it is returned to the filter again. The length of time for scraping, washing, returning and placing the sand in the bed is usually one day, although this has been done in 6 hours. Each bed will filter about 50,000,000 gal. between scrapings.

The filters at the time of the report had been in operation about 16 months. The tricklers showed no

signs of clogging, and the iron did not appear to penetrate the sand farther than expected. F. E. Forbes is superintendent of waterworks.

Domestic Sanitary Heating Engineers Meet in Montreal

THE Canadian Society of Domestic, Sanitary and Heating Engineers recently held its 23rd annual convention in Montreal. Besides holding several business sessions, the delegates took part in a diversified programme of entertainments. The convention passed a resolution urging that the federal government should take up the question of a federal plumbing code, regulating and controlling sanitary installations throughout the Dominion, or at least formulate a code which could be administered by provincial authorities. The creation of a Federal Health Department suggested that this step might be taken in conjunction with that movement.

A joint conference was held between the convention delegates and representatives of the wholesalers and manufacturers of plumbing and heating materials, and in the course of the discussion the urgency of giving greater publicity to the need of adequate sanitary installations, heating equipment, etc., both in private and public buildings, was insisted upon.

The following officers were elected: President, F. R. Maxwell, Toronto; vice-president, H. Mahoney, Guelph; secretary, G. F. Frankland, Toronto; vice-presidents for the different provinces, Quebec, J. A. Lavigne, Montreal; Ontario, T. J. Minnes, Brantford; New Brunswick, W. C. Crawford, St. John; Prince Edward Island, Thomas Johnson, Summerside; Saskatchewan, N. B. Roantree, Swift Current; Alberta, James Marr, Calgary. John Wright, of Toronto, was appointed chairman of the sanitary committee, D. A. Bethune and T. Latourelle, of Montreal, heads of the heat and ventilation committees. J. T. Blyth, of Ottawa, was elected chairman of the legislative committee. E. A. Russell, London, Ont., will act as chairman of the essay committee, and George Clapperton, Toronto, will direct the apprenticeship committee. The next convention will take place in Toronto.

The programme of papers included one by Mr. G. F. Frankland, Toronto, on overhead expenses in the plumbing business, and another on modern heating by Mr. A. J. Dickey. Mr. A. Charette, of Montreal, presided at all the business sessions.

New Low Level Reached in Trinidad Asphalt Lake Soundings

RECENT borings made in the famous asphalt lake on the Island of Trinidad have reached a new low level record of 150 feet. The previous record, made in 1893, was 135 feet. On both occasions the asphalt was found to be of uniform character throughout. These latest attempts to find the bottom of the great mass of asphalt were conducted by George A. Macready, geologist, at the instance of Dr. Clifford Richardson who has studied this asphalt wonder for many years. Great difficulties attend any attempt to sound the lake as it is in constant, though almost imperceptible motion. The pressure of the mass of asphalt at any great depth against the drilling apparatus causes it to bend and the deflection from the perpendicular is so great that further boring is prohibited.

In the borings which have just been made, a core

of asphalt was taken by driving a small pipe into the pitch and then withdrawing it with its contained core of pitch. Following this, a pipe of 2-inch diameter was driven to the lowest depth to which the core was taken and the material forced into it by driving, was removed by means of a water jet and bit. Another core was taken below the 2-inch pipe in the untouched pipe. The deepest of these borings was taken at the centre of the pitch lake and the asphalt was found to be of uniform character throughout. After completion, this hole was observed to have shifted at the surface 25 feet in six weeks; a survey showed the movement to exist as deep as 100 feet, and there was a suggestion that the direction was reversed at a depth of between 25 and 50 feet. The other borings, not at the centre of the lake, shifted to a lesser extent. The movement of the asphalt seems to be similar in many respects to the ascending and descending currents in a kettle of boiling water.

The problem presented is difficult of solution, as it seems to be impossible to find any material which will withstand the bending strain imposed upon it by the pressure of the mass of semi-solid asphalt.

Three hundred and forty miles of extensions of railway lines in the West, as well as some new lines are to be built by the Canadian National Railways. These new constructions are chiefly for Saskatchewan.

At the annual meeting of the Vancouver branch of the Engineering Institute of Canada the following officers were elected for the 1919-20 session: Chairman, E. G. Matheson; vice-chairman, Newton J. Kerr; secretary-treasurer, A. G. Dalzell; executive committee, Messrs. C. Brakenridge, Major W. G. Swan, D.S.O., Major G. A. Walkem and W. Anderson; ex-officio members, Messrs. R. F. Hayward and J. H. Kennedy.

The Council of Verdun, P.Q., has decided to submit by-laws to the citizens authorizing the borrowing of \$502,925 for two 5,000,000-gallon electric pumps, a 4,000,000-gallon filtration plant, and about 4,000 feet of 24-inch water main in the street, at an approximate cost of \$246,775; a 1,000 K.W. steam turbine generator and boilers, at an approximate cost of \$150,000, and an incineration plant for the destruction of garbage, which plant may also be used for the production of power, with the necessary dyke, etc., at an approximate cost of \$106,150. Mr. Charles Brandeis, C.E., reported on these proposed works.

The Board of Directors of the Association of Montreal Building and Construction Industries recently received a deputation of the manufacturers of finished lumber, Messrs. Rutherford, Traversy and Mathieu, who invited the co-operation of the board in securing from the architects more details in working drawings, suggesting that the architects should themselves furnish the lists of quantities of material required on the various jobs. It was pointed out that during the war there might have been some reason for turning out small scale drawings without sufficient details, but now that the country was settling down to peace conditions and more draftsmen and estimators were available there seemed to be no reason why drawings should not be as clear and complete as possible. The proprietor also would save money, it was added, if clearer and fuller details were given. The co-operation of the Board was promised.

Open Highways in Winter

Year-Round Travel Has Been Demonstrated with Success and is a Possibility on all Roads

By Hon. Frank Carrel*

IT is safe to look into the future and prognosticate the use of the motor car upon our winter roads, because there is no great obstacle to such a materialization, except that the time is not quite ripe for its profitable operation, under all conditions of our climate, in some sections of the Dominion. I do, however, want to emphasize the fact that if we are to look forward to the day when we may expect to treat our winter roads for motor traffic, it will be necessary, first of all, to have a solid road surface to work upon, and on this point let me say that the better the construction of the road the easier will it be to make the winter highway trafficable for motor cars.

There is another important point to be studied in the consideration of this subject. There must be greater production, more modern, scientific agricultural knowledge imparted to our farmers, and more economic and business-like management of farms. When this is accomplished there will be increased farming, village and town populations, and, in consequence, a larger number of automobiles upon our highways, transporting this immense farm production to the markets. You will see by this that the future use of winter roads for motor traffic, depends indirectly upon the increased production and population of any district where there is a heavy fall of snow, and where sleighs are used at the present time.

Demonstration of Year-Round Traffic

But for those who may have any doubts on the subject, let me give some present-day facts, to substantiate these opinions. It is not so very long ago that the people of the city of Quebec, which is graced with a winter of several months, ridiculed the idea of a street railway being in full operation in winter time. To-day it is a rare thing to see even a blockade on our tracks for a few hours. But what is even more astounding is the large number of motor cars which were in commission in the streets of Quebec, and Montreal during the recent winter, proving conclusively, the feasibility of operating motor traffic upon winter roads. To offer still further evidence, it might be mentioned that the "Quebec Telegraph" delivered its papers to its one hundred and six agents, in all parts of the city, even in the suburban streets, every day but seven, during last winter, and were it not for the fact that its trucks have to go into the back streets so frequently, it could have accomplished this work every day. These cars travel over twenty-five miles of streets in Quebec every day of the winter. To even prophesy the use of the motor truck upon our winter streets a few years ago, would have been considered a sign of unsound mental balance. Nevertheless, we can as readily believe to-day that once a thought becomes a convinced idea, there is no limit to its realization, and just as soon as the population and the number of cars increase in our rural districts, we will say on the main highway between Quebec and Montreal, so surely will you see the efficient manner in which such encumbrances as snow banks disappear, and the road kept open. Almost every day in the win-

ter a motor car is capable of using the road to Montmorency Falls, which is so well travelled that the snow packs hard enough to carry the weight of an automobile. This is exactly what will happen with other roads when they become as thickly bordered by inhabitants and as largely used as is this thoroughfare. It may be mentioned that the average fall of snow in Quebec is 10.9 feet. Where the fall is below two or three feet, its removal is a simple task.

Tank May Solve the Problem

The late world struggle has opened our eyes to the possibilities of utilizing a mechanically-driven machine, the tank, that may revolutionize road making and certainly assure the feasibility, even in its present shape and motion, with few changes, of its being used for tramping down the soft snow into a hardened, packed mass, solid enough to sustain automobile traffic.

Perhaps, too, we may even prognosticate that the width of the motor car wheels and the sleigh runners, will some day run in the same tracks. Even the horses are destined to give up their middle tracks on our Quebec roads and follow the runner tracks, which will relieve them of much of their present-day travelling energy. All these manifest reforms are signs of the times portending to teach us that there is nothing new under the sun and that all things are possible to man's aggressive combat with nature.

But perhaps the most convincing evidence in favor of winter roads for the automobile and motor truck is to be seen in the mechanically steam-hauled train of logs. If this process of transportation can be carried on over the deep snow in our backwoods, where there is no regular road traffic and where the snow piles many feet high, how less difficult will it be to carry on the same kind of traffic on well-beaten and snow-packed highways.

Existing Methods

To-day the system of keeping our winter roads open is as old as the history of the country. The line of passage is along that of the least resistance from wind and snow piles. It may be across fields and pastures, between a farmer's back door and his barn, instead of several hundred yards or feet from his front door or it may be along the ice over a river or lake. Wherever it is, and if for any reason it is likely to be lost to view, it is marked out with what are known as light sapins, (les balisses) a small thin tree, which is of little commercial value. Over it, after each snow storm, passes an improvised rural plough and, sometimes, but not often, a wooden roller. Ploughs are of all descriptions with a preference for the V-shaped ones. From time to time, ruts are filled in and drifts cut through with the aid of shovels.

One thing certain, when left to himself, the farmer is not overzealous or anxious to keep his winter roads in the pink of condition, even though it is the season when he has more time to do it in. Roadmaking to the farmer, is one of his distractions, and not being a man who takes much pleasure out of life, he too frequently absents himself from such imaginative waste of energy. With the excellent missionary efforts of the Good Roads Association, whose objective is real road propaganda of the very highest and most practical form, he is beginning to see eye to eye with the city man, and believes that there is a good deal more benefit coming to him, by having good roads, than he ever dreamed of before. The farmer is not any

* Vice-President of the Canadian Automobile Association before Canadian Good Roads Congress.

different in thought to those who hold the opinion to-day that it will be impossible to keep our winter roads open for motor traffic, but our past dreams of improved roads and speedy road traffic are being materialized in such quick order that it should prompt us to look into the future and believe that there are many more visions on this subject which we would not even dare to mention to-day, and which will be realized as time goes on.

There is, however, considerable satisfaction for the present generation, in observing the rapid growth of our road transportation, and all those provinces and municipalities of Canada which have been the most progressive in this direction must feel very proud of their present-day achievement, for the reason that their judgment was sound and the people of their respective districts, including the farmers, have reaped an enormous benefit, both financially and otherwise, from the foresight of those administrations who have favored and supported a universal movement for good roads.

Movement is Spreading

If we only keep to those dreams which we are seeing realized in this and other provinces in Canada, in our good road policy, we have much to be thankful for. There is a sense of satisfaction in being able to recognize that this movement in favor of good roads is spreading so rapidly throughout the country that our governments are now embarrassed to find sufficient financial resources which they were so willingly prepared to offer some years ago. The farmer to-day is as intelligent in his belief of the great benefit to be derived from good roads, as is any other body of good road advocates, and just as soon as he thinks he wants to use his car in winter as much as he does in summer, you will see the roads kept in condition to be used by him for that purpose.

Definite Policy on Naval Defence is Suggested

The proposed visit of Admiral Lord Jellicoe to this country is made the occasion of a strong plea in the June issue of "The Sailor" for a definite policy on naval defence and, as a basis of argument, the following policy is suggested:

That Canada and the other Dominions should take over the responsibility of protecting trade and sea communications of the Empire in time of war and subordinate their naval programmes to that function entirely; and that Great Britain should retain the responsibility of maintaining the battle fleet, with its proper accompaniment of cruisers, etc., necessary to uphold whatever world policy the Empire decides is proper.

The article states that this policy, like all other policies, is open to certain objections, but it is believed that the advantages more than outweigh the criticisms that can be made against it. These advantages are summed up somewhat as follows:

1. The purely **defensive** characteristics of the arrangement. It cannot be contended that such a policy is militaristic or aggressive in design. It has been clearly stated in the words of the most responsible advocates of the League of Nations that such an instrument cannot be expected to end all wars, consequently, if the Empire is to exist, proper defence measures **must** be taken, that is, if we are to be at the same time worthy heirs to the heroes who built and left us our precious heritage, and unimpeachable trustees for our successors.

2. The inter-dependence which such an arrangement involves between the component parts of the Empire will form a material bond far stronger than sentiment and Imperialistic speeches. Co-ordinated action in the matter of defence will do more than anything else to counteract the centrifugal tendencies of peace conditions, which are perhaps as much, or even more, due to the insidious propaganda of outside parties interested in the disruption of the Empire,

than to any really conflicting interests born of trade rivalries or national aspirations.

3. The ease with which the machinery for defence can be manipulated in case of war or emergency, when each unit has its allotted task beforehand, instead of having to compromise between the conflicting requirements of Maritime defence.

4. The independence of action of each Dominion Navy under its own administrative heads, thus relieving the Admiralty of one of its most serious responsibilities. Interchange of individual vessels or of divisions throughout the Empire in peace time is advocated in order to encourage uniformity of system and mutual understanding.

5. Economy in expenditure owing to concentration of effort, also greater efficiency resulting from concentrated study on particular spheres of Naval action and consequent expert knowledge.

6. And by no means least, the moral effect in time of peace of showing the flag of the Empire in all the waters of the globe co-operating in an organized system of defence.

Trade Incorporations

H. M. Symmes & Company, Limited, head office at Montreal, capital \$25,000, to carry on business of contractors and builders.

Wentworth Construction Company, Limited, head office at Hamilton, capital \$40,000, to carry on the business of contractors, builders, etc.

The Robert Fitzsimmons Company, Limited, head office at Hamilton, capital \$50,000, to carry on the business of engineering and manufacturing of piping of all kinds.

Trade Publications

The Trussed Concrete Steel Company of Canada, Limited, has issued a folder describing the nature and use of "Agatex" a preparation for making concrete floors wear-proof, dust-proof and sand-proof.

New Books

"52 Questions on the Nationalization of Canadian Railways," by "Fabius." Gives in question and answer form reasons for the retaining of Canadian railways under private ownership. Published by F. M. Dent & Sons, Limited; 127 pages, size 4½ in. by 6½ in., cloth.

"The 20th edition of Trautwine's Civil Engineer's Pocket Book," like former editions, is an exhaustive treatise, in convenient form, on railroad and other branches of engineering coming within the scope of the civil engineer's activities. With its 1451 pages, it is more extensive than the 19th edition, which made its appearance ten years ago. About 400 pages of type have been set relating principally to matters connected with railroads; the remainder of the book is practically the same as in the former editions, excepting that advantage has been taken of the present changes to effect a radical and important improvement in the arrangement of several articles. No attempt has been made to produce a general revision of the matter or even a discussion of all matters pertaining to railroads, but rather the authors have confined themselves to modernizing and extending the articles on certain railroad topics and the introduction of new data on others. The data throughout the book has been modernized and brought up-to-date. Special pains have been taken to ensure freedom from typographical errors and one noticeable feature is the use, in the case of complicated figures, of lines in red as well as in black, such distinction offering increased clearness. Published by Trautwine Company; size 4½ in. by 6½ in., leather, gilt edge, thumb index. Price \$6.00.

Construction in Montreal for the month of May this year shows an increase over the same period last year of \$518,755.

Personals

H. F. McCarthy has resigned the position of chairman of the Board of Works, Ingersoll, Ont., through ill health. R. A. Skinner was appointed in his place.

At the annual meeting of P. Lyall & Sons Construction Company, Montreal, held recently, Major-General E. W. Wilson was elected a director of the company.

Mr. W. W. Hudson has been appointed engineer in charge of construction on the new refining mill of the Corundum Limited, Craigmont, Ont. Mr. Hudson was formerly with A. A. Scully Limited, Toronto.

Major-General F. O. W. Loomis, D.S.O., of the contracting firm of Loomis and Sons, Montreal, has been made a Knight Commander of the Bath. The new Knight went overseas with the first contingent; was appointed officer commanding the 13th, a year later was gazetted Brigadier-General, and in June of the same year was awarded the D.S.O. In June, 1917, he was given the C.M.G., and he is also an Officer of the Legion of Honor. He has also been several times mentioned in despatches. Sir F. O. W. Loomis has seen long service in France. During an absence on leave in Canada he addressed the Montreal Builders' Exchange on his experience at the front.

Obituary

Mr. John P. Mealowcroft, managing director of Garth & Co., plumbing and heating contractors, Montreal, died on June 6, after a long illness, aged 64.

Mainly Constructional

East and West—From Coast to Coast

A hospital for the insane is to be erected at Ponoka, Alta., at a cost of \$267,500.

Tenders will shortly be called for construction of a court house at Medicine Hat to cost \$250,000.

The Clare Milling Company will shortly invite tenders for a \$375,000 flour mill at St. Boniface, Man.

A by-law is being submitted to the ratepayers of Parry Sound as to the construction of a power plant.

Tenders will shortly be called for a building to cost about \$150,000 for the Hudson Bay Co. at Calgary.

The Toronto carpenters went back to work last week on the basis of a 44-hour week at 70 cents an hour.

The city of Kitchener, Ont., is threatened with a water famine, as the result of the breaking down of the pumps.

The Canadian National Railway plans the construction of a spur line near St. Ubaldo, Que., to connect up new mines.

Federal aid to the extent of \$62,500, has been granted towards construction of addition to St. John, N.B., hospital.

The Canadian Pacific Railway contemplate extensive alterations and improvements at the Chateau Frontenac, Quebec.

The expansion program of the Hudson Bay Company includes the erection of new buildings at Vancouver, B.C., and Edmonton, Alta.

The Public Works Dept., Ottawa, will shortly call for tenders for harbor improvements at Port Dover, Ont., to cost about \$300,000.

The Canadian Northern Railway will construct 340 miles of extensions to western lines. Most of this work will be on lines in the Saskatchewan district.

The Board of Trade, Brockville, Ont., has purchased twenty-four acres of land, which it intends to dispose of to United States manufacturers for factory sites.

Excavation work will start next week at New Toronto for the first houses under the Ontario Housing Scheme, for which the village has a promise of some \$200,000.

Work has been commenced on the construction of the extension of the Porcupine branch of the T. & N. O. Ry., from Timmins to Mattagami Heights, on the Mattagami River.

Point Claire, P.Q., intends making application for a loan of \$280,000 for house-building throughout the township as soon as the housing commission announce they are "open for business."

The competition for the Soldiers' Memorial and Civic Centre for the Town of Renfrew, Ont., has been decided and the work awarded to the firm of Millson and Burgess, architects, of Ottawa.

The Ottawa Garden Suburbs and Housing Association are building on a site behind Rideau Hall, 75 houses costing from \$3,500 to \$4,500 each. The houses will be frame, with brick or stucco veneer.

At a recent meeting of the council of the town of Cobourg a housing commission was appointed composed of the following members: Messrs. the Mayor, Hayden, Hargraft, Quinn and Harrison.

On June 30th the citizens of Niagara Falls, Ont., will vote on a by-law to raise \$50,000, half the cost of a new 100-bed hospital, and also to raise money to buy an incinerator for the disposal of garbage.

The total in building permits issued at Guelph, Ontario, for the first five months of the present year is \$239,120. The total for the month of May, \$176,630, was more than double the amount for the whole of last year.

Building permits issued by the engineering department of the city of Welland, Ont., for the month of May are considerably lower than the total for the same month last year, being only \$19,840, compared with \$93,029 for May, 1918.

Four-room schools will be erected at the following points in Manitoba: Plum Coulee, Riverton, Oakmer district and Graymer district. In addition to the above program many additions will be built to schools throughout the province.

Delegates to the convention of the Canadian Society of Domestic, Sanitary and Heating Engineers at Montreal, considered reports on laws relating to plumbing and sanitation in every province, with the purpose of formulating model laws for towns and cities throughout Canada.

The Housing Commission of Whitby, Ont., has elected the following officers: Chairman, W. H. Kennedy; vice-chairman, F. L. Beecroft; secretary, M. M. Gibson. Major E. R. Blev and M. T. C. Deverell are also members of the executive.

The Board of Education of Kingston, Ont., has approved of the plans for the new ten-room school to be erected in Catarqui ward, and tenders will be called in the near future. The new school will face on Bagot street, and will be modern in every respect.

Foundations are now being laid for what is stated to be the largest public garage in Toronto. The building is situated on the north side of Danforth Avenue, and has a frontage of 66 feet by 100 feet deep. It is expected to be completed early in July.

A two-storey brick and stone building will be erected at the corner of Queen and Bay streets, Toronto, for the Dominion Bank. It is rumored that the cost of this site was in the neighborhood of \$300,000. The city is now negotiating with the bank for the purchase of a five-foot strip

on Bay street and on Queen street for the widening of the corner.

It is reported that Baldwins, one of the most important European steel firms, have arranged for the purchase of the British Forgings Company, whose extensive works at Toronto were erected by the Imperial Munitions Board of Canada for the production of high-grade steel.

The Toronto Housing Commission have purchased a block of land south of the Lake Shore road and intend building fifty houses upon it. These houses will sell from \$3,000 to \$3,600, and will have four or five different designs to break the monotony of a row of buildings.

The Domestic, Sanitary and Heating Engineers and Plumbers and Steamfitters Union, Toronto, announce that a voluntary increase of 10 cents an hour has been granted the workers in these trades, making the minimum wage 75 cents an hour. This increase will affect about 400 men in the city.

Contracts for reconstruction work in France, aggregating 200,000,000 francs, covering the rebuilding of the destroyed area of Rheims, Nancy and Soissons, have been awarded to American firms. The official representatives of the chief company—a steel corporation—are now on their way to the United States.

The residents of Puslinch Township, Ont., will erect a granite memorial to the soldiers from this township who made the supreme sacrifice in France. The design selected is a massive pedestal with the figure of a Canadian soldier on the top. The monument will be erected on a hill in the centre of the fair grounds at Aberfoyle.

The Government's loan of \$300,000 for housing purposes being now available, the city of Victoria, B.C., will immediately proceed with plans for the construction of houses. The maximum loan to an applicant for acquiring the site and construction, or for construction only, is \$4,500. Repayment is extended over a period of twenty years.

At a private meeting with the Board of Control recently, the Toronto Harbor Commissioners requested that the city proceed with its share of the lake front boulevard work between Sunnyside and the Humber River. This work, which is provided for under the original agreement with the Harbor Commission, would cost the city \$300,000.

C. A. P. Turner, C.E., a reinforced concrete specialist from the United States, is in Toronto in reference to the designing of the new building for the Northern Aluminum Company. The building is to be 280 by 60 feet and will be 90 feet high. There will be eight storeys, which will make it actually a ten-storey building, and it will be of reinforced concrete.

Two model farm buildings will shortly be erected at Point Grey, B.C., one a beef barn, adaptable to both cattle and horses, and the other a dairy produce building, which will contain all modern facilities for scientific butter making and the care of milk in general. These buildings will constitute part of the university agricultural course equipment and will cost about \$11,500 to erect.

Hon. Frank Carvell, while in Toronto recently, made a close inspection of the water front and harbor improvements, expressing himself as pleased with the progress that had been made. Hon. Mr. Carvell promised to bring the matter of protection against storms of the island and lake shores to the attention of his colleagues in Ottawa and urge upon them the importance of prompt action.

Hamilton, Ont., is having an active season in the erection of houses. The total number of permits issued during the first five months of this year is 537, most of these being for dwellings, while for the corresponding period last year, there were 298 permits issued. The Hoover Vacuum

Cleaner Company is building a plant, the front portion of which is 75 x 80, four storeys in height, and the rear, containing the factory, 100 x 1,000, single storey, saw-tooth roof construction. Porrits & Spencer, felt manufacturers, of Bury, England, also propose to erect a factory in Hamilton, and will start building within a month.

The General Motors of Canada, Limited, have announced part of their extension policy at Oshawa, Ont. A new four-storey plant, 400 feet by 80 feet, will be erected to assemble Oldsmobiles and trucks. A central shipping building, 200 feet by 80 feet, with a capacity of 56 freight cars under roof, will be erected, so that inclement weather will not handicap shipping operations. An enamelling plant, 300 feet by 80 feet, three storeys, equipped with the most modern facilities for efficiency and mammoth production, will also be erected. In addition to the above, extensive alterations and improvements will be made on the present plant.

GOOD ROADS ACTIVITIES

The amount appropriated by Frontenac County, Ont., for road work this year, is \$68,400. The heavy rains this spring have had a very injurious effect upon the roads.

Operations have been commenced on the construction of the Government road along the towpath from Humberstone to Welland, Ont. The road will have a centre of nine or twelve feet in width, and will be constructed of concrete with a four-foot macadam shoulder on each side of the concrete centre.

Owen Sound, Ont., has decided upon a good roads program involving an initial outlay of \$100,000. The corporation will pay fifty per cent. of the cost of construction, the balance being chargeable on the lands abutting directly on the road. The present outlay is but the forerunner of a larger scheme embracing all the principal streets in the town.

The bill introduced to the Federal Government several weeks ago by Hon. Dr. Reid, to provide \$20,000,000 for highways, has just received one reading, and, with the end of the session in sight, there is some doubt as to whether the Government intends proceeding with the bill. Provinces have built up good roads programs and it will be a tremendous handicap all over Canada if federal aid is not forthcoming.

A resolution introduced at the Saskatchewan Motor League Convention, held in Saskatoon recently, was "that the Government be memorialized by the Saskatchewan Motor League to enact legislation so that all the revenue derived from license fees be used for the making and maintenance of roads, and that they should also issue debentures to the amount of at least \$20,000,000 for this purpose, this loan to be reduced at the rate of \$1,000,000 per annum, and the revenue from licenses applied upon this." The resolution was adopted.

C. J. Yorath, City Commissioner of Saskatoon, addressing the members of the Saskatchewan Motor League Convention, stated that, according to figures of the Provincial Highways Department, \$6,000,000 was spent during the years 1912-1914 inclusive, and during the first three years of the war approximately \$2,100,000 was expended on roads.

The London Motor Club, London, Ont., in co-operation with the city and county officials, have started a campaign to have the road between St. Thomas and Port Stanley oiled, in the interests of safety. The Provincial Highway Department will contribute 40 per cent. of the cost, which would total upwards of \$9,000, while the councils of London and St. Thomas, and probably Middlesex and Elgin, will be asked to subscribe. Three thousand London car owners are reported to be anxious to contribute.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Elleville, Ont.

Tenders received by City Clerk, J. Wilfred Holmes, until 5 p.m. June 26th, for reconstruction of drain. Engineer, J. G. Mill.

Casselman, Ont.

By-law will be voted on June 30th, for construction of bituminous macadam roadway, \$14,000, for Town Council. Clerk, Jos. Martin.

Comber, Ont.

Plans will be prepared and tenders will be called shortly for construction of concrete pavement for Town and County Councils. Clerk, W. P. Coyle, Windsor.

Dundas, Ont.

Tenders received by Chairman, A. W. Draeseke, until June 23rd, for construction of sewers and sewage disposal works, etc. Town clerk, John S. Fry.

Goderich, Ont.

Town Council has passed by-law for \$10,861 for construction of sewers.

Haileybury, Ont.

Town Council plans waterworks improvements. Clerk, Theo. H. Connor.

Hawkesbury, Ont.

Town Council plans construction of macadam roadway. Clerk, Eugene Paquette.

Holstein, Ont.

Tenders received by clerk, David Allan, until July 3rd, for deepening municipal drain, for Township Council.

Kerwood, Ont.

Tenders received by Township Clerk, Harry Thompson, R. R. No. 2, Kerwood, until June 23rd, for construction of tile drains.

Lennoxville, Que.

Plans and specifications are with sec-treas., W. W. Baker, who is receiving tenders until noon June 21st, for graveling roads, for Township of Ascot.

Milverton, Ont.

Tenders received by engineer, John Roger, Mitchell, Ont., until noon, June 20th, for construction of pavement and curbing, for County Council.

North Bay, Ont.

Town Council has passed by-law for \$21,000 to extend water mains and improve pump house and \$9,500 for sidewalks.

Owen Sound, Ont.

Plans are in progress and tenders will be called July 1st, for construction of pavements, for City Council. Engineer, D. H. Fleming.

Pike River, Que.

Work will start soon macadamizing

roads for Municipality. Mayor, Her-menegilde Rocheleau.

Sarnia, Ont.

Specifications, etc., are with engineer, John A. Baird, who is receiving tenders until noon, June 23rd, for resurfacing asphalt pavements, for City Council.

Shawinigan Falls, Que.

Work has started for sewers, \$32,000. City clerk, A. J. Meunier.

Strathmore, Que.

Tenders are open for repairs to roads and sidewalks for Town Council.

Three Rivers, Que.

Work has started for reservoir for North Shore Power Co. Manager, W. Baptist.

Tillsonburg, Ont.

Work will start shortly macadamizing road, \$10,000, for Town Council. Clerk, A. E. Raynes.

Timmins, Ont.

Tenders received by Town Clerk, H. E. Montgomery, until 6 p. m., June 24th, for material and installation of sewers and water mains. Engineer, Sutcliffe & Neelands, New Liskeard.

Toronto, Ont.

Plans and specifications are with engineer, Frank Barber, 40 Jarvis St., who is receiving tenders until noon, June 23rd, for construction of pavements for Township Council.

Tenders received by chairman of Board of Control, T. L. Church, City Hall, until June 24th, for construction of sewer on Kippendavie Ave.

Victoriaville, Que.

Municipal Council has passed by-law for \$25,000 for road improvements. Sec-treas., J. Garneau.

Wallaceburg, Ont.

Tenders received by Town Clerk, C. B. Jackson, until 6 p. m., June 20th, for construction of approximately 38,000 sq. yds. of paving. Engineer, L. G. McNeice.

Watford, Ont.

By-law will be voted on June 30th, for construction of waterworks system, \$52,000, for Town Council. Clerk, W. S. Fuller.

Welland, Ont.

Plans are in progress for pavement, \$18,000, for Welland County Council. Engineer, Geo. Ross.

Tenders received by Township clerk, H. L. Pratt, until June 24th for construction of concrete pavement, \$15,000. Engineer, Geo. Ross.

Windsor, Ont.

Plans are in progress for concrete pavement and curb, \$23,000, for City Council. Engineer, M. E. Brien, City Hall.

Woodstock, Ont.

Tenders will be called soon for con-

struction of sewer, \$63,000, for City Council. Clerk, John Morrison.

Zurich, Ont.

Tenders received by Township clerk, A. F. Hess, until June 21st, for culverts and concrete work.

CONTRACTS AWARDED

Brantford, Ont.

Pavement for City Council: Concrete pavement, concrete curb and gutter, R. S. Sheehy, 751 George St., Peterboro; tarvia resurfacing, McCrea, Compaigne & Cook, Niagara Falls; concrete resurfacing, S. B. Begg, St. Catharines.

Ottawa, Ont.

Asphalt pavement, \$117,000, for City Council: General contractor, Ottawa Construction Co., Central Chhrs.

Asphalt pavement, \$10,000, for City Council: General contractor, A. Leary Ltd., National Bank Bldg.

Quebec, Que.

Drainage and waterworks, \$8,000, for City Council: General contractor, Ignace Bilodeau, 144 Renaud Ave.

Sarnia, Ont.

Twenty-four inch intake pipe, \$60,000, for City Council: General contractor, Dunbar & Sullivan, care of engineer, John A. Baird.

Ste. Anne De Bellevue, Que.

Grading and road work for Department of Public Works, Ottawa: General contractor, J. Kent & Son, 1008 Delorimer Ave., Montreal.

St. Thomas, Ont.

Permanent pavements for City Council: General contractor, Standard Paving Co., Ltd., Central Chmbrs, Ottawa.

Railroads, Bridges and Wharves

Cap Rouge, Que.

Tenders received until June 21st, for rebuilding railway for C. N. Rly., Toronto. Chief engineer, A. F. Stewart, 27 Wellington St. E., Toronto.

Fort William, Que.

Tenders received by R. C. Desrochers, secretary of Department of Public Works, Ottawa, until noon, July 2nd, for repairs and improvements to pilework wharf.

Goderich, Ont.

Plans will be prepared for three bridges for County Council. Clerk, C. W. Holman.

Grand Bend, Ont.

Huron and Lambton County Councils plan construction of bridge. Clerks, John Dalziel, Sarnia, and C. W. Holman, Goderich.

Guelph, Ont.

City Council plans construction of

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A "Higher Efficiency" Issue

BUILDING and construction activities have been seriously handicapped by the present conditions of unrest and uncertainty which seem to have arisen in industry all over the world as a kind of reaction following the war. Practically every country in the world is faced with difficulties of the same nature as we are struggling with in Canada—though varying in the degree of seriousness. One fact seems evident: that the country which solves its problems most rapidly and most successfully and comes to a level—not the old level, but a new "normal"—will have a big advantage in the international competition which lies ahead of us.

All this is apropos of "Higher Efficiency," and it was owing to these conditions that we considered it particularly opportune to issue a "Higher Efficiency" Number of the Contract Record. One of the big difficulties which results from the circumstances mentioned is high costs and, temporarily at least, decreased productive power in many industries. The construction industry is hit as hard as any other. Many projects which we thought would proceed with all haste upon the cessation of hostilities are still in the back-ground, and their promoters are waiting for "more normal conditions" and "lower costs." Lower labor costs are not a likelihood, and the abnormal conditions actually consist in this hesitancy on the part of those who hold the reins of industrial enterprise. Wherein lies the remedy? Higher efficiency. The only possible method we see of reducing costs and thus inducing concerns to build is by being more efficient.

In getting together this "Higher Efficiency" Number, we have thought it well to deal with the subject in a broad way, taking into consideration the various factors which bear upon it. There is the big question of efficient management in the field and in the office, there is mechanical efficiency, manual efficiency and personal efficiency. From the broader viewpoint there has to be considered the labor situation in its relation to efficiency, the advantages of organizing the men of the industry and of co-operation between engineers, architects and contractors. We hope that the contractors of Canada will give these important questions their attention, and that the result will be a real stimulus to the industry in which we are all vitally interested.

The Vital Element in Efficiency

THERE are many who rail at efficiency as a mechanical system which overlooks the essentially human element, seeking to make the brain act like a slide rule and the hand like a flexible gear. Doubtless in many cases the criticism is fully justified. Many so-called systems of efficiency have been installed which are dehumanizing to the workers, systems in which a man is called upon to do one minute or trifling operation perhaps several thousand times in one day, always with the exactly the same motion, always machine-like without using his brain. Work of this kind, if long sustained, is bound to have a very deleterious, if not actually a degrading, effect upon human beings, and while output will temporarily be increased, the final result is bound to be a decrease in efficiency, due to a lower physical and mental standard among the workers. However, there is the possibility that with a short work-day and proper facilities for recreation, the worker may be able to counteract the deadening influence of his monotonous task. It is our belief that we

will yet see such perfection of mechanical devices that the human being will be eliminated as a mere part of the machine, and every man will have only such work to perform as requires, to some extent at least, the exercise of his brain and of his personality.

It seems that one of the greatest mistakes in our industrial system to-day is the lamentable waste of brain power and individuality. The average worker has more brains than is necessary for the laying of bricks or driving of rivets. These operations require only a combination of manual training and physical energy, though, of course, character has a considerable effect upon the quality of the work. Why should the ideas of the worker be wasted? If he were trained to make greater use of his head, he would become more interested in his work, he would put more personality into it and he might produce valuable ideas. The average man doesn't produce ideas because he doesn't think. If the co-operation of the workers were asked in pointing out weak spots in organization and improving methods, wouldn't their practical experience and knowledge of actual conditions, place them in a position to make suggestions that would be of benefit? Wouldn't it tend to raise the morale of the working force? We think so.

System is good. System, plus driving force, gives efficiency. But there is still another factor to be considered—originality. Originality is the charm that relieves system of its monotony, humanizes it, vitalizes it and increases its effectiveness a hundred-fold. It's a fine thing to profit by the experience of others, but why not try and originate ideas of your own, why not use the brains of your workmen to improve your methods, and thus introduce in your organization at once, an efficiency and an individuality that will make it stand out from all others by virtue of the unique quality of the service it renders.

Scientific Management Applied to Construction

ELSEWHERE in this issue we print an article by Mr. Daniel J. Hauer, C.E., construction economist and consulting engineer, on "Modern Management as Applied to Construction." This subject, which has also been dealt with in more detail by Mr. Hauer in his book of the same title, is one of paramount importance and really comprises the whole question of efficiency in its more limited sense, as it concerns practical construction work.

Modern management, as the author points out, begins right with the estimating and must be applied all along the line. One of the first essentials is planning ahead and working to a standard. Nothing should be left to guesswork, but the whole programme of operations should be mapped out beforehand and this programme should be strictly adhered to throughout the work. Contingencies may, of course, arise which could not be foreseen and which may necessitate a modification of the contractor's plans. He may have to change his original schedule, but the point is to have a schedule and work to it.

Another important point is the keeping of records of each job and applying the experience gained to subsequent work. The necessity of a proper cost-keeping system cannot be too strongly emphasized. Without it the contractor is really in the dark as to how his business is running.

In the actual construction work, adherence to a proper plan, as mentioned above, eliminates the confu-

sion which so often exists on jobs where the scheme of operations has not been fully worked out beforehand, and one of the most effective ways of reducing costs is through the use of labor-saving machinery.

Modern management is a means of securing more rapid and better work and lower costs, and contractors who have not yet applied it to their business are missing an opportunity for increasing their profits and lessening their troubles. We believe that the present condition of high costs and decreased production will force action along this line upon the business men of every industry.

Steel of High Elastic Limit Recommended for Reinforcement

THE use of steel of high elastic limit for concrete reinforcement is advocated by the Burlington Steel Company, Limited, as a means of reducing costs and entailing savings in building operations. "The most important thing in concrete reinforcement," they state, "is the tense strength and elastic limit of the reinforcing bar. Other things being equal, steel having the highest elastic limit or yield point will be the most satisfactory for reinforcement. When under strain, as soon as the elastic limit of any reinforcing bar is reached, the metal stretches, rapidly decreasing in section, drawing loose from the concrete and destroying the monolithic bond existing before this point is reached. Therefore the safety of the entire construction is in direct proportion to the elastic limit of the steel used."

"The elastic limit of rail carbon steel is 50,000 to 60,000 lbs. per square inch, either twisted or plain, as compared with the elastic limit of 25,000 to 30,000 lbs. in soft steel. Our argument is that practically all the reinforcing steel is used in tension. Steel, therefore, with a yield point of 50,000 lbs., is superior to steel with a yield point of 30,000 to the extent of the difference in the yield point. The American Society of Testing Materials, in 1914, drew up specifications for reinforcing steel rolled from high carbon material, which were revised in 1916. The city architect of Toronto is now permitting 18,000 lb. fibre stress on high elastic limit steel of rail carbon stock. This practice is also followed out by a great many American cities. This is in comparison with soft billet steel for which is allowed a fibre stress of only 16,000 lbs.

"We think that engineers and contractors will be well advised to consider the use of high carbon steel for concrete reinforcing, as, by its use there is a larger factor of safety and a saving in quantity of steel required which reduces costs considerably."

Mr. L. H. Veronneau, manager of the Simplex Floor Finishing Co., Montreal, has returned from a visit to Europe. He states that reconstruction of the destroyed areas has not yet made any great progress. Mr. Veronneau, however, thinks that work will soon be commenced in earnest. He proposes to again visit England, particularly in connection with an exhibition at Newcastle-on-Tyne, when he will show a number of floor finishing appliances and samples of lumber which have been finished by the company's methods.

The Association of Electrical Contractors of Montreal decided at their last meeting not to recognize any trade union, leaving it to each firm or individual to deal with the union as it felt fit.

Modern Management Methods, Applied to Construction, Mean Higher Efficiency

The Contractor Who Adopts a Scientific Scheme of Planning and Organization Opens the Way to Greater and More Certain Profits

By Daniel J. Hauer, C. E.*

"I can't be done. It can't be done," said the old and experienced contractor. "For I know," he stated, "from my experience that on such a small structure it is not possible to work enough men to complete the job in twenty days. Besides you have a camp to build, plant to assemble, an organization to perfect, and one hundred and one details that such an important and intricate concrete structure as this demands."

"Let me explain," said the efficiency expert, "just how I intend to do this. I have the entire thing outlined here on paper. First of all, I have the quantities of work to be done supplemented with the plans of the structure and sketches of the forms for the concrete, the layout and operation of the excavating machinery, sketches of all the temporary structures, besides the camp buildings, water system, and other details. Next, I have the time schedules, showing each successive step which allows me to complete the job in seventeen days, giving me three days' grace, allowing time for delays due to rain and unforeseen conditions. Now don't interrupt me, let me show you my entire plan. Here I have lists of the materials I am to receive, how they are to be stored and handled. Next, I have the forces and plant layout that I will need to complete the job within the time limit. This includes both day and night gang. Here is a list of things needed to protect the work and men from inclement weather, so that there will be no interruption. I even have a schedule for feeding the men during the placing of the concrete, so that the work will not stop even for meals, and with auxiliary mixers, a breakdown will not stop the work. Here, too, are the plans for the camp, with the same schedules——"

"This is the first time I ever saw a job done on paper," interrupted the contractor, with a laugh, "and I am more than ever convinced that such management will amount to nothing. Go ahead and push the work and if you get it done in four or five weeks you will be lucky."

"It can't be done," said the engineer. "Your plans on paper may work out, but I am like the man from Missouri, you've got to show me."

"I have my doubts also," put in the army officer, "for I have never seen a structure of this character built in less than three months, even when some night work was done."

Without being dismayed, the efficiency expert took off his coat and went to work, following his plans and schedules as obediently as though they had been instructions issued to him instead of his own making. Unforeseen conditions arose, breakdowns occurred, changes were made by the engineer in the plans of the structure, and even parts were relocated after considerable work had been done, but revision was made at once in the working plans and schedules, and again they were followed until the job was completed on

the night of the twentieth day, and put into use on the morning of the twenty-first day after the work was commenced. The man from Missouri was shown as well as the others, but they were not convinced, stating that it was due to good management rather than to the planning of the work in advance. This illustrates in a striking manner that modern management, based on intimate knowledge and scientific methods, is good management and gives higher efficiency, allowing what is seemingly impossible to be done quickly and at times at a low cost. In the case recited, the cost was not low, for the object here was to complete the structure in the limited time rather than to save money.

In most cases greater efficiency goes with reduction in costs. A contractor had been for three months building wagon roads in a mountainous section of the country. His job had been developed. He had his machinery at work and large forces of men employed. His progress was satisfactory, but his costs were so high as to show a considerable money loss on the job. He called in a construction economist to find out where his leaks were occurring and put the job, if possible, on a paying basis.

Superintendents, partners, engineers in charge of the work and others smiled when the economist arrived, but within sixty days such changes were made as to cut out any wastes, reducing the forces, installing new machines, and with a payroll and other expenses reduced more than thirty per cent., the daily amount of work accomplished was increased over three hundred per cent. Upon looking over the economist's report and a trial balance from his books, the contractor exclaimed with an oath, "I'll be —— if I don't make a handsome profit on this job yet," And he did.

Modern Management Defined

These two recitals tell the entire story of modern management as applied to construction. Its application means higher efficiency, that is rapid construction and low costs, so that a profit is made by the contractor; not any old profit, as one contractor stated, but the greatest possible profit.

Modern management is sometimes termed scientific management. Both have had varying definitions. In the broad sense, it is easily defined as the substitution of machine methods for hand work and obsolete ideas; planning all work in advance from accurate and intimate knowledge, leaving nothing to be guessed at, or for chance; the keeping of accurate records for these purposes; the selection of men, machines and methods, the elimination of waste by working to a standard, all of these being set down in writing or upon plans and sketches, so that they are followed by every member of the contractor's organization, including himself.

Loyalty to the "Job."

This is the greatest test of management, namely, "obedience." Obedience to the plans and specifications, to the rules and regulations, to the written and verbal instruction, to the lay-out of the job; obedience of the

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highest official down to the humblest workman. Coupled with obedience must come loyalty to the job. This loyalty is the esprit de corps of the organization, and must centre around and in the job. The word, "job," is used instead of the name of a structure, for it can stand for any character of a structure or for any kind of construction work. The word should always be written in large capitals, so as to impress it upon the minds of all. It should stand out like the flag of a great nation, so that all can be loyal to it and work for it. When so emphasized, "THE JOB," there can be no question that all service and devotion will be centered in it.

Efficiency Will.

The first requisite for this loyalty, this devotion, and the application of modern management to obtain the higher efficiency desired is "efficiency will."

In the abstract every man agrees that higher efficiency is desirable. Every man wishes to be efficient. There is a hue and cry throughout the world for methods of greater efficiency in every line of endeavor. This issue of the Contract Record is to promote greater efficiency among the contractors and engineers of Canada. Thousands will read it, commend it, yet it and all other desires for increased efficiency will be of no avail without that state of mind on the part of engineers and contractors to apply it. Intentions of future application mean little, the mind must become fixed so that it will inaugurate the application of this higher efficiency immediately. Until this is done there is no "efficiency will," and there will not be in that organization any "higher efficiency."

There's a Reason

Every contractor who does not have this efficiency will give many excuses and reasons why he is not employing modern management and methods on his jobs. The writer visited an eastern Canadian port, where two large buildings were being built, one on each side of the harbor. The foundation work on each structure was strikingly similar. One job was being done by a Canadian contractor of wide experience, by modern methods that meant the saving of much time and thousands of dollars. The other job was under the direction of one of the largest construction companies that operate in the Dominion and the States. Here everything was in disorder, the methods were crude and most of the work was being done by hand, while machinery lay idle on the ground. It was evident that the cost was excessive as compared to the other job. The attention of the manager was called to this and he was asked why he was not following some of the methods used on the job across the harbor. His reply was, "My job is different, and I must do the work as I am doing it." This is the excuse of hundreds of men, when they actually believe it, and also when they know nothing of the other jobs, as was the case with this manager, for later he stated that although he had been in the city for three or four months, he had never visited the other job. Several visits would have been helpful to him.

Every job is slightly different from other jobs. Even for such work as cement sidewalks, a monotonous class of work, every job has slightly varying conditions, yet it is surprising how the details of many jobs are similar when the proper analysis is made. The general principles are always the same.

"I can't use a machine for excavation on this job," said one contractor engaged in laying electric tracks in a city, "for there are pipes in the street that pre-

vent the use of machines." This was true. By actual count there were less than ten one-inch pipes in almost a thousand feet and these were found a few inches above the bottom of the excavation. If the excavator had torn these out so that they had to be replaced, the cost would have been much less than that of doing the work by hand methods, or if the excavator had worked down to the pipes and the rest had been done by hand, hundreds of dollars would have been saved. "There's a reason," is an overworked excuse for not doing what we don't wish to do, but most excuses will not stand close scrutiny. With "efficiency will" excuses are not made, but results are obtained.

Estimating on Jobs

Modern management, as applied to construction, begins with estimating upon new jobs. If competitive bidding must be done, then the fruits of past management should be reflected in the tender. Estimating should never be done by guessing, but should be based upon an analysis of data collected on the jobs of the past. This data may be in the form of actual costs of work done or upon the man or machine units accomplished.

A word here as to cost keeping and cost data will not be amiss. Cost records even as to details, and kept to the fraction of a cent, should be the rule on every job. These records should be made daily and analyzed into various units as promptly as made. This means that units of work done, as well as units of cost should be recorded for this purpose. It is also necessary to make notes as to weather, surrounding conditions and even the specifications under which the work may be done.

Such records are of value when estimates and tenders are to be made upon new jobs, but the greatest value is in managing the job. With such records known daily, wastes are discovered at once and mistakes are rectified promptly. It is possible to know who are the competent superintendents and foremen, retaining those and discharging the incompetent ones. The basis of all cost keeping should be for management and the highest efficiency in the management of construction can only be obtained when cost records are kept. Having kept and used costs for managing jobs, it is possible to use them in estimating.

As costs effect management and methods effect costs, it should be evident that a close and accurate estimate of cost cannot be made until it is decided just what methods are to be used and the kind of plant that is to be employed. In other words, the job must be planned so as to make up a tender intelligently.

The general methods must be decided upon, the type of machines to be used and all the general features. If those things are done mentally and the contract is not awarded for several months, many of the decisions may be forgotten. Then, too, it is possible that one or two men make up the tender, while some other man may manage the job and execute the contract. Accordingly he would not know what the estimators had in mind. Consequently everything should be set down upon paper.

Two facts must be kept in mind. Estimating is important. Money cannot be made on a job if the tender made is too low, but a reasonable tender, based upon economical methods and with good management may make a fair profit upon a job, while a loss will be sustained if there is poor management or uneconomical

methods are followed. Intelligent estimating must be followed by intelligent execution and management if money is to be made.

Estimates should always be based upon known costs of labor and materials. Those for materials can be obtained from manufacturers and dealers. The labor costs must come from known rates and estimates of probable increases.

Thus, in making up estimates of costs, there should first be prepared sheets giving rates of wages, quotations on materials and supplies, quantities of work to be done, special clauses of specifications that will affect the cost of the work, sketches and plans showing methods of doing work, building forms, erecting scaffolds, lay-outs and lists of plant, and in some cases for rapid construction time schedules should be mapped out. These data, with the plans, give the estimators the knowledge to begin their figuring.

Another set of sheets with all schedules of work on them should be prepared for the estimating. These sheets, with the first set, are kept, first, to be used to start and manage the job, if it is secured, and, second, to be used in estimating on future jobs. Upon the second set of sheets every detail of the job is figured out. Nothing is left for guessing. Even the calculations are kept so that they may be checked.

This kind of estimating does not always mean the low tenders, but it does mean safe ones. The responsible contractor cannot afford to be always the low bidder. Irresponsible or inexperienced men are always bidding upon both public and private contracts, men who bid without knowledge or depend upon skimping the work to make a profit. Most of them come to grief, reaping only trouble instead of profit. Responsible experienced contractors cannot compete with such.

Planning Construction

A job once secured, the real planning of the work commences. The modern way does not necessarily mean a fast start, does not mean that money is saved at first, nor even that the construction cost may be low. It does mean, though that, when the work is well under way, the costs will be kept at the minimum, while the progress will be the maximum. Under old methods, a job may be started immediately, and money carried from the start, but the costs are likely to be excessive and are likely to continue so, unless changes can be made, based upon a scientific study of the job, and modern methods of management substituted for the old ideas, as was done upon the road job mentioned in the beginning of this article.

Preparation should always be made for starting jobs, every detail considered, plant assembled, organization perfected and materials secured and delivered at the proper places.

Some years ago the writer was engaged upon building timber bridges for railroads upon a large scale. After executing several jobs it was decided to use improved methods. Time was taken to plan and lay out the work, build travellers and hoists for doing the erecting. The successful methods practised by steel companies in erecting steel bridges were studied and copied for such details as were applicable to timber bridges. The result was that during the first thirty days on a new job little progress was made as to erection, and no money was earned except for timber delivered, but once this stage of preparation was over the progress was so rapid that the job was finished in less time than even some smaller jobs had been

done, and the cost was reduced nearly twenty-five per cent. The comment upon this record by the leading railroad journal of the country was that unusual work had been done. It was the result of careful planning and almost perfect system.

The concrete structure mentioned at the beginning of this article, showed little progress in actual construction during the first ten days, so little that nearly every one said: "I told you so, it can't be done," but the next ten days showed a completed structure.

To start the planning of a job the papers used in making up the estimates are called into play. These, with the plans of the structures to be built are used to lay out the job so that every detail can be planned in advance. On some cases surveys and sketches must be made of the ground at points along the job, or of the ground surrounding the structure. From such surveys the layout of the plant will be made and also the storing and handling of materials will be decided and marked upon plots.

Careful consideration will have to be given to the plant that will be needed. It is not the part of modern business to make a man do any work that a machine can do for the same or less money. During the world's war, it was a great shame, in carrying on the vast amount of construction found necessary in America to help win the war, to see the vast amount of hard work that was done, when machines would have been both faster and cheaper. Men were scarce and wages high, yet they were crowded together in such numbers that one man interfered with another, when, in many cases, machines could have been employed and the men used in work that machines could not do.

The type of plant and the size and number of machines must be decided upon. It must not be left to the men on the ground to install these machines as they see fit, but this must be decided and instructions written out where and how to install them, charts being used, if necessary, and marks employed to show the movement of the machines.

For materials to be used, charts should be prepared to show where and how the materials are to be distributed and stored. It may even be necessary to illustrate how various kinds of materials are to be handled and piled, either by rough sketches or photographs. This means that materials will not have to be re-handled and that they will be piled and stored for the lowest costs. It was by the crude methods followed during the world's war that thousands of dollars were wasted in handling and storing materials. Nearly all of this work was left to foremen and laborers, or else to inexperienced material clerks, some of them boys just out of school.

To handle materials economically, a schedule must be made of where they are to be used and the amount needed at each place. Without this information the distribution of material is all guess work and guessing must be eliminated from contracting.

If concrete forms are to be used, if temporary buildings are needed, or platforms or scaffolds must be erected, then either standard or special plans must be prepared, and with each should go a bill of material. It is evident that if an estimator has figured a low cost upon concrete forms, due to some special design that he has gotten up, this design with full instruction should be furnished to the erector of such forms, otherwise the latter is likely to follow his own ideas, which may be much more expensive, both as to materials and labor. If furnished a set of plans,

the erector knows just as well how to frame and erect the forms wanted as he knows what kind of a concrete structure to build from the engineer's plans.

The question is often asked as to who is to do the planning of a job. If it is a small one and the contractor handles his own work then he is the one to make up the plans. If a manager or superintendent is employed, then he assists the contractor, or he makes up the plans subject to the approval of the contractor. If the contract is a large one, upon which an extensive organization is employed, then the engineers, superintendents, or men, especially employed for the purpose, make up the plans subject to the approval of the manager and contractor. These things must vary with the size of the organization.

Time and Work Schedules

With the general plans and layouts made with the necessary instructions written out, the schedules of work can be gotten up and then the time schedules made. All of these may have to be revised later, but this is readily done. The general manager of a construction job may be likened to the commanding officer of an army. He plans his campaign and issues instructions, but as the enemy changes position, or as mistakes are made by his officers and other unforeseen things happen, changes are made in his plans and new instructions issued. The fact that changes must be made does not prevent him from making his original plans and issuing his instructions and orders. It is the science of warfare, just as it is the science of management.

From these schedules it is possible to estimate the number and size of the gangs of men that must be employed. With this done the general plans are completed and the next step is the deciding of the details and the actual handling of the men and machines. The organization must now be taken into consideration.

Instructions to Workmen

General rules and regulations can be the same on every job. Thus it is possible to get these up and have them made into book-form. They can be illustrated if this is found desirable. Forms for various kinds of reports can be shown properly filled out, and all of those things that are not special for a particular job can be covered. Such books can be issued to foremen and mechanics that need them for their guidance.

For each job there must be special instructions and working diagrams gotten up. These are issued to the different mechanics. If stone is to be cut, a card showing the dimensions of the stone and its different faces, sketched upon it, is issued. Instructions are given on the card as to the finishing and any other details that cannot be shown on the sketches. Space can also be provided for the number of stones to be cut and dressed in this manner. Also space to show the number of men engaged in doing this work and the time consumed. Thus these cards are used not only for instruction, but also for cost keeping.

Similar cards with slight variations as to the spaces and instructions are also used in erecting buildings. All the framing of timbers can be handled in the same manner, as likewise forms for concrete structures. The fact is that these cards or sheets are adapted for all kinds of special instructions. Most mechanics can read and understand reading drawings, so that instructions can be issued to them in this manner, but this is not the case with common laborers. The most

intelligent can be handled in this manner, but many of them must be instructed by word of mouth. This can be done by issuing the instructions to the foremen, or to those laborers who can read and have them to instruct the others, verbally.

It is with these instructions that the knowledge gleaned from the entire organization can be used. Mechanics and workmen know how to cheapen many details and handle them to save time. This information will be given when instructions are issued so that they can be revised.

Routing Work

In connection with instructions regarding construction, the sequence of the operation and the routing of work must be considered. This subject must be treated from a broad view-point. The success of the entire job may depend upon this feature. In building construction the rapidity and cheapness of construction will depend upon how well this part of the planning is handled.

However, in some classes of work the sequence is self evident, as in road construction, when the examination is first, the base of the road, second, and the top or finish, third. With all of these things attended to, the job is ready to be started.

Starting a Job

Too many jobs are started before things are made ready or plant installed or material received. Only recently the writer had experience in starting a job too soon. Paving work was to be done for a municipality, and the contractor commenced before a public works inspector was sent to the job. Thus only work that he did not have to pass upon could be done until he arrived. This interfered with the proper sequence of the work, causing too many pavements to be ripped up before new ones could be laid. Then the materials were not arranged for promptly, causing further delay. This caused the entire job to be so confused that for some weeks the expenses exceeded the earnings. Furthermore the job had to be stopped several times, thus losing the best men and breaking up the organization. It was not until the job was properly systematized and planned that it began to go smoothly, and a profit was earned.

Even with the most careful planning there are always delays and mistakes made, but with scientific management the job starts off with less of these, and once started it moves along smoothly.

Each man quickly learns what is expected of him, and machine operators know what outputs must be obtained. The daily reports keep the contractor advised of what work is done each day and its cost. If the various men employed have an interest in their work, the job will go along with limited suspension, but it is never well to count too much on this. Eternal vigilance is the price of success, yet one man can oversee more work when things work smoothly than when tie-ups occur and mistakes are made, and the manager must stay for hours on one part of the job.

Men can be given an interest in the work by paying fair wages and seeing that the time made is recorded properly and their pay is correct. Dissatisfied men on pay day mean poor work between pay days and the losing of many good men from the organization.

After a fair wage is set a further incentive can be given the men by setting tasks, paying bonuses, and even making contracts with the men to perform certain labor. Thus workmen are taught to think and

also to put forth their best efforts. By these methods the cost of suspension is cut down, and nearly all overhead charges are reduced. This method of handling men must be started with great care, for a basis must first be obtained that is fair to both the contractor and the men, and the method adopted must be continued until the end of the job. To make many changes in the basis of pay is to cause the men to be suspicious and distrustful of their employer, with the result that they will object to any method of payment except straight wages.

Applying Modern Management

It is much easier to write of the methods and application of modern management than it is to put them into effect. The contractor himself is frequently skeptical. He may be very enthusiastic at first, but when some objections are made he becomes uncertain as to the benefits of new methods and ideas, so that he is soon back in the old rut.

Superintendents believe that they are being robbed of their prerogative and that they may lose their standing with their employers, so that they put obstacles in the way of carrying out instructions, and they both object to and ridicule the new ideas. Foremen are apt to act in the same manner and they may have justification for this, for they are the ones to suffer, for in some cases the number of foremen employed can be considerably reduced. They, though, are the only ones to suffer.

Workmen, especially union men, are likely to object to some ideas of modern management, but inasmuch as they are benefitted, if the men are handled

with care until they obtain some of this benefit, they can be quickly won over.

However, there is nothing that is not practical, for every detail is formed upon both practice and theory. The results, in many cases, show it. For more than two decades the principles of modern management have been applied successfully to manufacturing and for over half of this period of time construction jobs have been handled in this manner. At first only a few jobs, but the number has gradually increased.

Books are a great help in this, and much can be done to introduce and apply the principles by a contractor and his managers to an organization. Efficiency experts or construction economists can be employed and made a part of the organization with satisfactory results, but the greatest benefit is derived by employing economists as consultants—men of experience who, instead of entering the organization, work from an outside viewpoint, and do not come under the general manager. He co-operates and advises, rather than dictates. He must make good, for he must save more money, much more, than he charges for his services, else his employment will cease. He is the one whose sole business is to discover the leaks and eliminate them, instead of handling and managing the job.

The question "when shall I apply modern management" is quickly answered. The time is now. If work is slack, the application is easier, while if a number of jobs are under way, the saving will be greater. If a job is well on to completion, the organization can learn much so as to apply it to a new job from the start. Higher efficiency is the watchword of the age.

Trench Digging Accelerated by "Task Work"

Application of Piece Work Principle to Digging of Communication Trenches in War Zone Results in Speedy Completion

By Major J. Morrow Oxley*

AN application of the piece-work principle to trench digging was tried out in France, and proved very successful both in increasing the amount dug per man per night and in shortening the working hours. A short description of one case will serve to illustrate the principle, although of course, there is nothing particularly new in the idea.

A main communication trench about one mile in length was to be dug, and as the work had to be done at night, being under enemy observation, it was estimated that each man would dig seventy cubic feet in each night's work. On this basis it would have required a party of two hundred men working fourteen nights to complete the job. There was a long tramp for the men to and from the job, and five to six hours digging was considered a good night's work.

Task Completed in Three Hours Instead of Six.

Instead of setting the men at the job to work for six hours a night, it was decided to handle it by "task work." The working party was organized in sections of eight to twelve men, each in charge of a non-commissioned officer. Each section was given a "task" for the night's work of a length of trench based

on a quantity of one hundred and twenty-five cubic feet to be dug per man. The task was apportioned to include the section leader as a digger, but in practice he did not remain at one spot but moved about his section giving a hand wherever it would do the most good. The section, on the completion of its task and its acceptance by the officer in charge was free to march back to billets.

With this arrangement the men dug into their job with a will and frequently the night's task was completed by most of the sections in three hours instead of six. The net result was that the trench was dug in ten nights instead of fourteen, the working party was reduced from two hundred to one hundred and sixty, giving twenty per cent. of the men a rest each night; the men and the officers discovered what a capable team of moles they were, and casualties were lessened owing to the shorter working hours.

One other point that served to increase the interest and efficiency of all concerned was that each day the officer in charge gave a short chalk-talk to the section leaders, explaining the result aimed at, and details of the methods of work to be applied.

Similar ideas might prove well worth adapting to and trying out on civilian jobs.

*Industrial engineer, Toronto.

Chippawa Power Development in all Phases is a Higher Efficiency Enterprise

Canada's Largest Piece of Construction Being Carried Through by a Unified Organization, Working With Equipment of Record Breaking Order

THE development of industry is quite largely a matter of dependable and cheap power. Coal, except in the immediate vicinity of the mine, does not produce cheap power. Further, its supply is limited and uncertain and constantly increasing in price, due to increased cost in labor and transportation over which, except in a very general way, we have no control.

We fall back then, necessarily, on our water power, of which fortunately we have a large supply. Water power is never-failing, inexhaustible over any term of years, subject in only a minor way to increased costs of other commodities and, finally, ideally capable of application to manufacturing and construction industries of every kind.

It follows, then, that if Canada is to become a nation of efficient workers, in any or all lines of industrial life, our water powers must be utilized to their fullest extent.

That is the reason a description of the great Chippawa power development of the Hydro-electric Power Commission of Ontario finds its proper place in this "Higher Efficiency" number of the "Contract Record." To begin with, this big development was undertaken so that two (and more) horsepower may be developed out of the same water which up to the present time has developed only one horsepower—that is higher efficiency at its best. Further, it is being put through at a time when many people entertain anticipations of a coal shortage and at the moment when young Canada (industrial) is upon the very threshold of an era of wonderful development. A third reason why a description of this work finds a place in our efficiency issue is found in the fact that this whole gigantic enterprise is being carried through as a unit, the same engineers and officers controlling the whole work, all plans being laid with a view to dovetailing in the various sections of the work—a condition that would be impossible if work on the different sections were being carried forward by different contractors. In a word, the work is one big organized unit, allowing of no duplications. This again spells greatest efficiency.

Thirteen-Mile Canal

The route of the big canal which will carry the water to the turbines at Queenston is shown in the map herewith. This route is about 12¾ miles long, with the intake on the Niagara River at Hog Island, Chippawa, about two miles above Niagara Falls. The tailrace is on the Niagara River about one mile above Queenston. The intake will be in what is known as the Grass Island Pool of the Niagara River. The mean monthly elevation of this pool varies about one foot.

The normal mean elevation of Lake Erie is 573 feet; of Grass Island Pool, 563; of the proposed power house site, 247; and of Lake Ontario, 245. Probably no river has a more uniform regimen than the Niagara. The minimum flow is about half the maximum,

and over a period of fifty years the maximum difference in mean monthly levels under normal conditions, either at Queenston or Chippawa, amounts to only about six feet.

The best intake and power house locations were first determined upon, with a view to the maximum utilization of the available head, and contours and borings were then studied to decide by what route a canal could connect those two points to the best hydraulic and economic advantage. The intake was located at Hog Island partly on account of that point being just above the critical section at which the water begins to speed up for its passage over the Falls. Location further up the river would have meant a larger canal and further downstream would have necessitated a loss of head. Another reason equally important for locating the intake at Chippawa was the use which could be made of the natural channel of the Welland River—often called Chippawa Creek—which comprises about 4¼ miles of the route of the Canal, leaving only about 8½ miles to be excavated, although the Welland River will have to be somewhat deepened. The flow of the Welland River, which is a sluggish stream with a very flat gradient, will be reversed for this 4¼ miles.

8½ Miles of Excavation

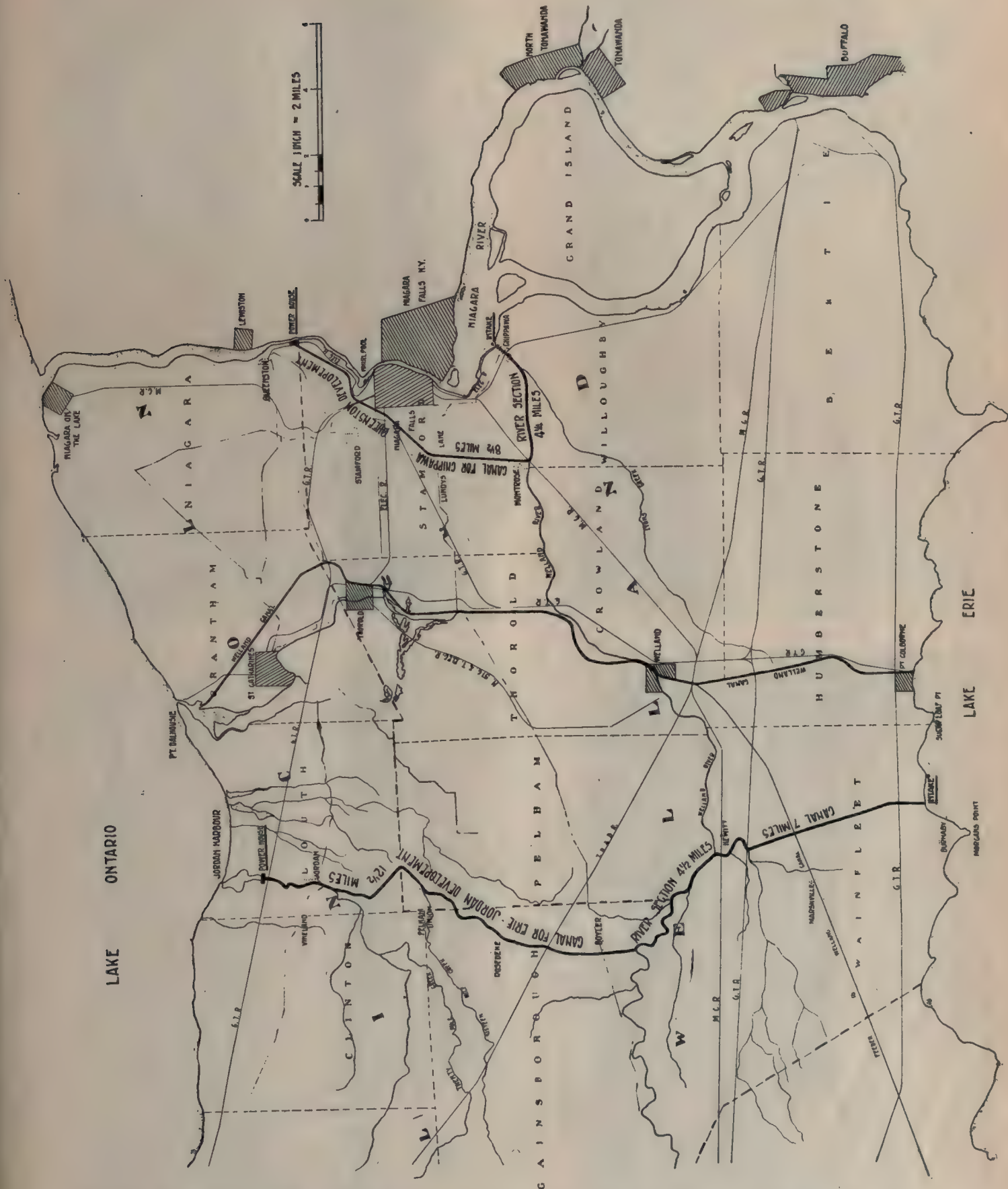
This 8½ miles of excavated section compared with 19½ miles for the old Jordan-Erie scheme, and the net head is 305 feet, compared with a possible 299 feet for the Jordan-Erie project. (see map)

The gradients adopted for the canal average about one foot per mile, or a total of about eight feet in the 8½ miles of excavated canal. The loss of head in the penstocks, due to friction, may amount to upwards of two and a half feet, and the loss in the Welland River from Hog Island to Montrose, where the excavated canal begins, will be about 6 inches, under maximum load, so that the total loss of head will be about 11 feet, making the net effective head about three hundred and five feet under normal conditions.

Thus, of the 327 feet normal difference in level between the two lakes, only 22 feet head will be lost—10 feet between Lake Erie and Hog Island, 11 feet between the intake and the tailrace, and two feet between the point of discharge of the tail water and Lake Ontario.

The power house will be located in the bottom of the gorge, about three-quarters of a mile above the Lewiston Bridge, just below where the last rough water disappears. The cliffs are nearly vertical at this point, and as the gatehouse will be on the cliff immediately above the power house, the penstocks will be nearly vertical and only about 450 feet long, thus reducing cost and head loss to a minimum.

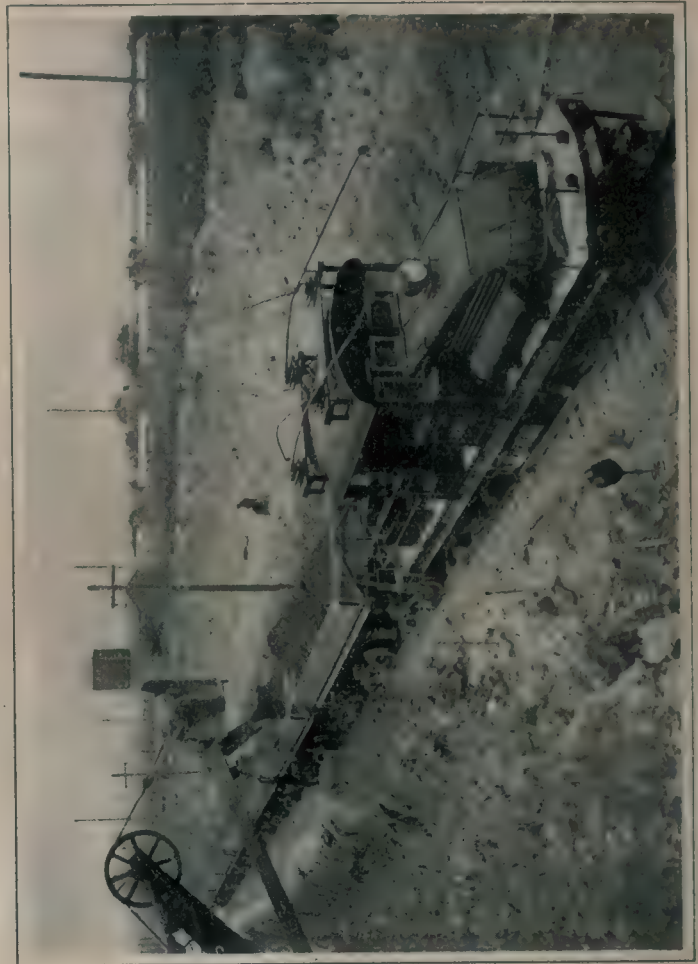
With this scheme of development about 30 h.p. will be obtained from each second-foot of water used, compared with about 14 h.p. per second-foot obtained by the existing plants at Niagara Falls. With



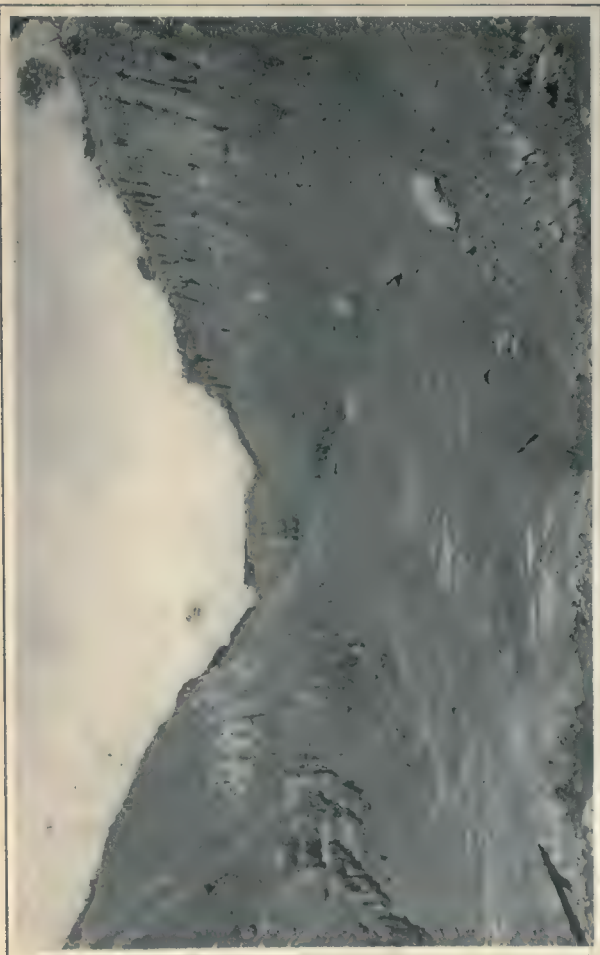
Map showing the general route of the Queenston development canal, four and a quarter miles up Welland River, eight and a half miles rock and earth cut. Compare Erie-Jordan route with nineteen and a half miles cut



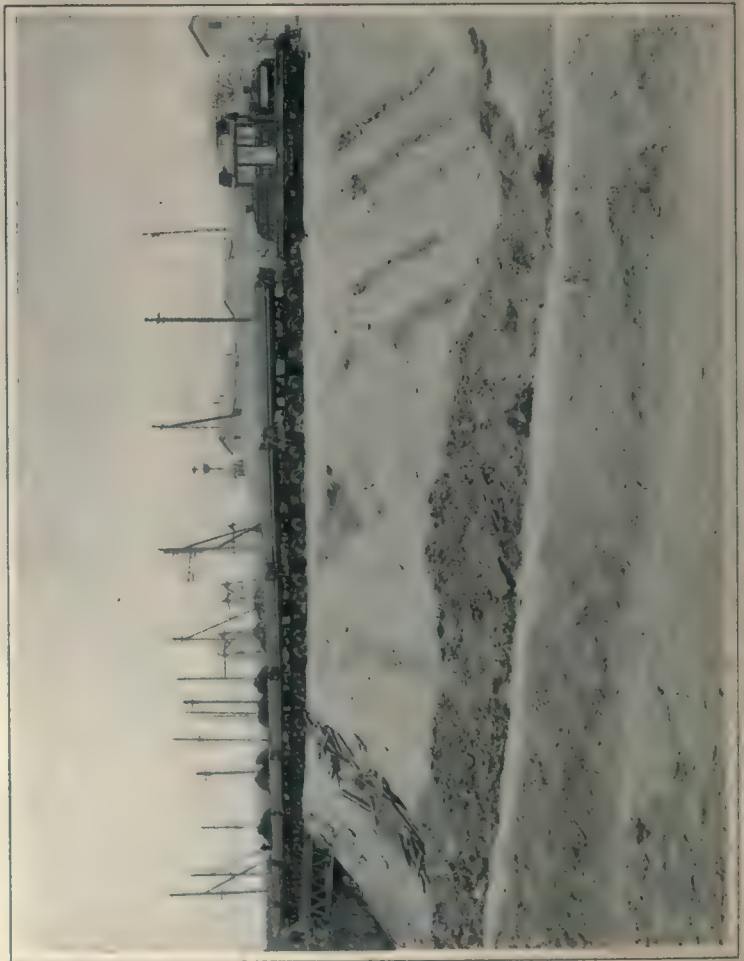
Dredging Welland River—bucket dumping. Load about 3 yards



Bucyrus in act of dumping 8 tons of earth



Excavation east from Bowman's Ravine late in 1918



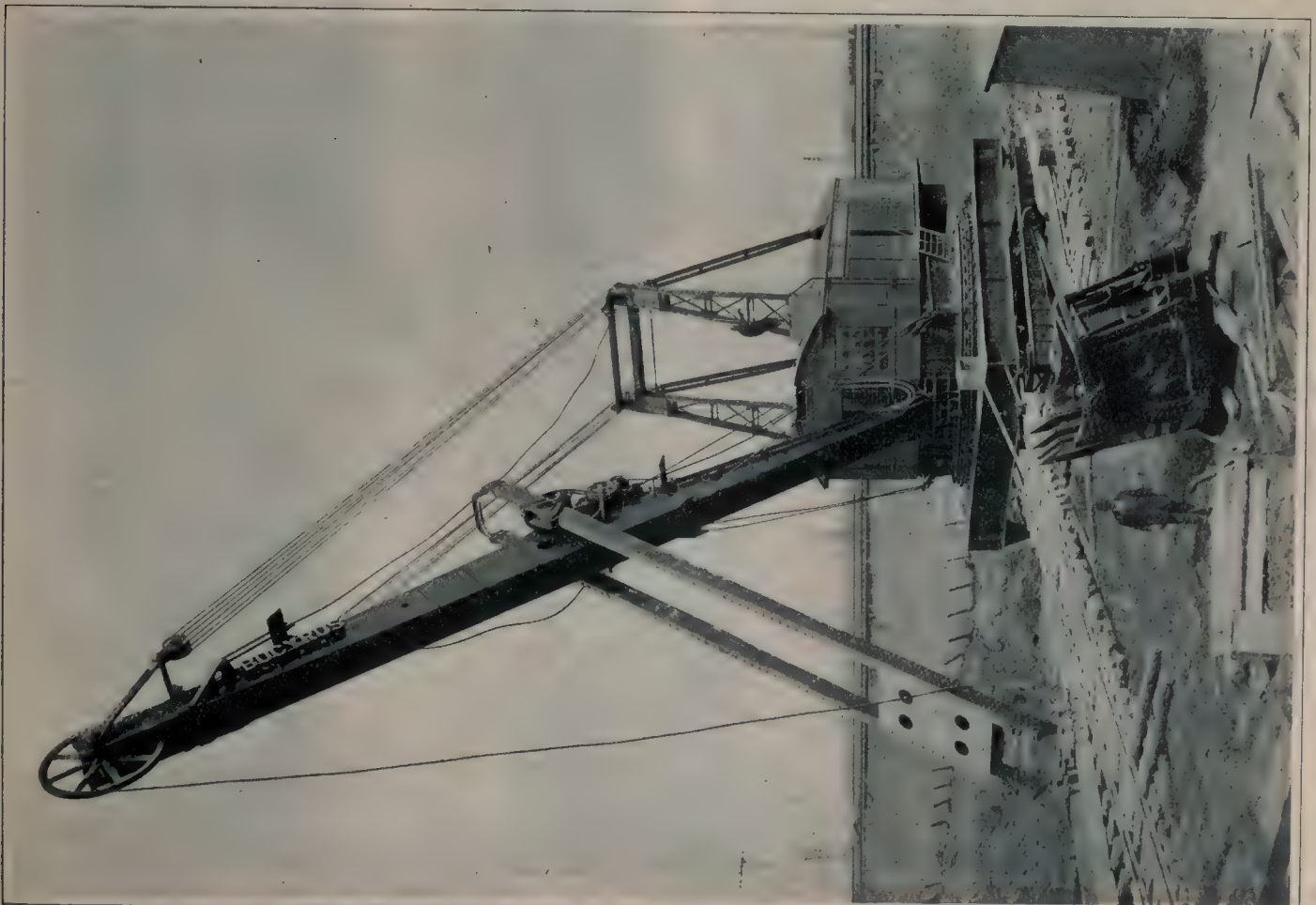
An electric locomotive and train of 20-yard dump cars. The usual train is 10 cars



Bucyrus shovel lifting 8 cubic yards of earth and loading cars 70 feet above



Big Bucyrus shovel loading cars, 8 tons at a time



Assembling one of the big Bucyrus shovels equipped with 750 h.p. motor—Lifts 8 to 10 cubic yards each time

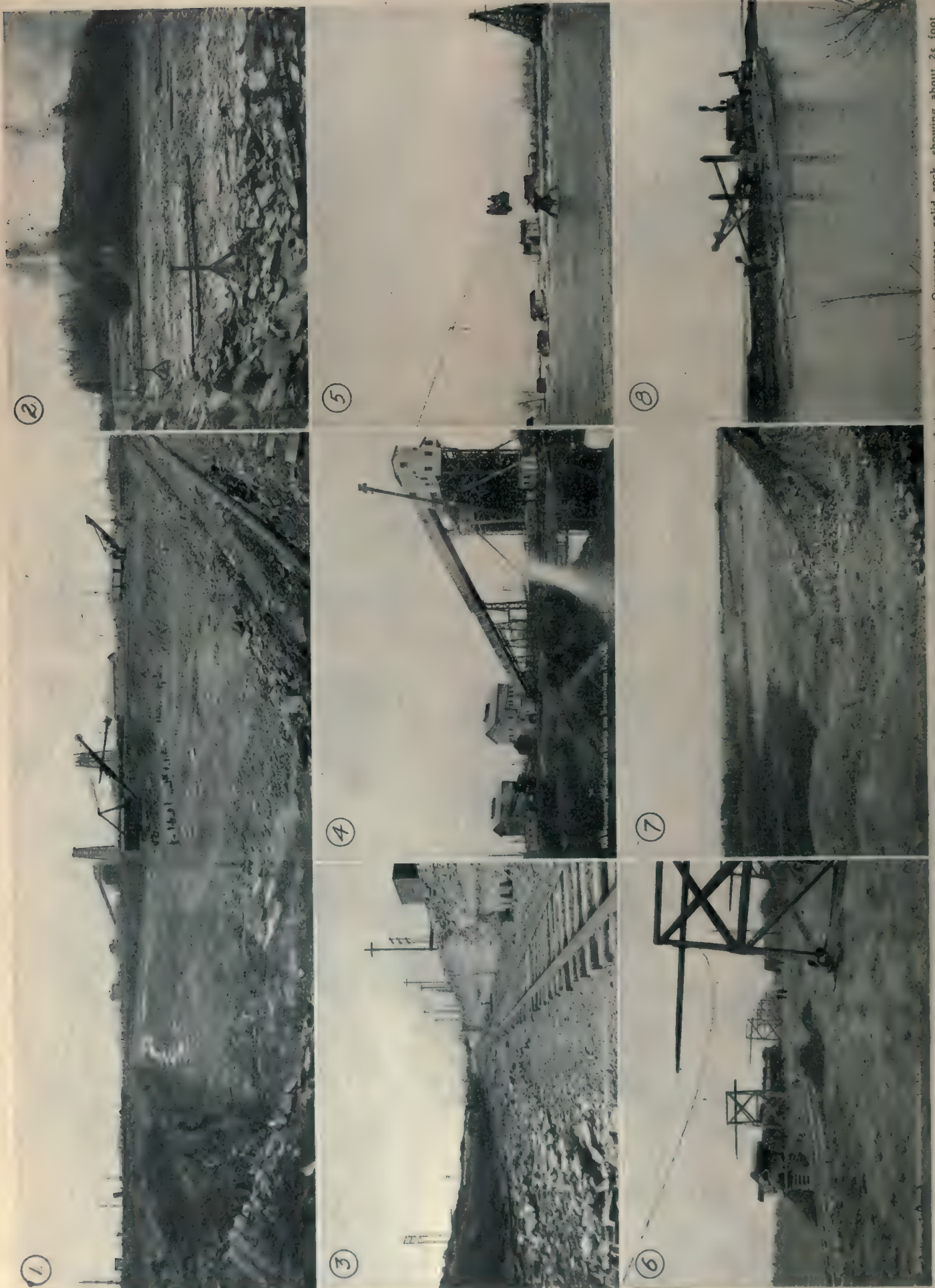


Fig. 1. View of forebay, taken from electric railway track which rests on the immediate crest of the bank above the proposed site of the power plant at Queenston—solid rock, showing about 25 foot in depth excavated. (2) View of forebay immediately following shot. (3) Looking up canal excavation from forebay. (4) Crusher plant. The rock is coarse crushed in the building at the left, transported on belt conveyor to the second building containing secondary crushers, and finally hoisted to the screen house on the extreme right of the picture. (5) Showing Lidgerwood cable bucket in operation, just rising with its 3-ton load; this bucket makes a trip every 2 minutes. (6) Large disposal area, showing load being dumped, also movable trolley-pole line. (7) Another view of disposal area; train of cars in distance being unloaded. (8) Dredging work under way at Hog Island, at entrance to Welland river; scows in distance being unloaded.

36,000, the whole treaty allotment of second feet available, over 1,000,000 h.p. can be developed.

All of the excavated section of the canal will be in solid rock, with the exception of $1\frac{1}{4}$ miles of earth section running north from the Welland River and half a mile of earth section across the whirlpool ravine. These sections will be trapezoidal in shape, lined with rip-rap. The section at the whirlpool will also be faced with concrete.

Rock Section

The rock section is 48 feet wide at the bottom, with perpendicular sides, the average wetted section being 35 feet deep and lined with concrete. The velocity in the rock section will be about 6 feet per second when the plant is under maximum load. The earth overburden above the rock surface will be generally sloped $1\frac{1}{2}$ to 1, but a flatter slope is provided for where local conditions require it.

The Commission has purchased a tract of land as a right-of-way which will be sufficient for all present and future needs. This right-of-way includes about 200 acres near St. David's which will be used as a dump for the disposal of excavated earth and rock.

At a point 2,400 feet distant from the gatehouse, the canal begins to widen into the forebay, the forebay gradually increasing in width to four hundred feet, which will be the approximate overall length of the gate house. The initial development provides for four steel penstocks each about 14 feet in diameter, 450 feet long; and one exciter penstock, about 5 feet diameter.

Provision is being made for the installation of four main generating units each of 50,000 h.p. capacity. Both the gate house and the power house are so designed that they may be extended whenever conditions warrant.

The surveys for the work were begun in 1914 and continued for nearly two years. During the year 1917 the construction plant was brought onto the job and assembled, and during the first part of 1918 the camps were completed.

The Three Largest Shovels Ever Built

The main equipment for the earth and rock excavation consists of the three largest electrically driven shovels ever built. They are of the revolving type, built by the Bucyrus Company, and are fitted with an 8-cubic-yard bucket for excavation in earth, and a 5-cubic-yard for rock work. The boom on these shovels is about 90 feet long, and the dipper stick 58 feet. Either shovel can load dump-cars which stand on a track the level of which is 62 feet above the level of tracks on which the shovel stands. The shovel rests on two tracks (four rails) 30 feet centre to centre and is mounted on 16 wheels. The nominal horsepower of each of the two shovels is 715 h.p., upon a half-hour intermittent rating. Each shovel weighs over 300 tons, contains 75 tons of ballast, and has a capacity of 3,000 to 5,000 cubic yards per 10 hour day when handling earth.

There are also five other electrically-driven shovels at work, having dipper capacities ranging from $\frac{7}{8}$ cubic yards to $4\frac{1}{2}$ cubic yards.

On the Welland River section of the canal, a Lidgerwood cable excavator is at work, fitted with a 3-cubic-yard Anderson-Evans clam. The cableway has an 80-foot head tower and 60-foot tail tower, and a

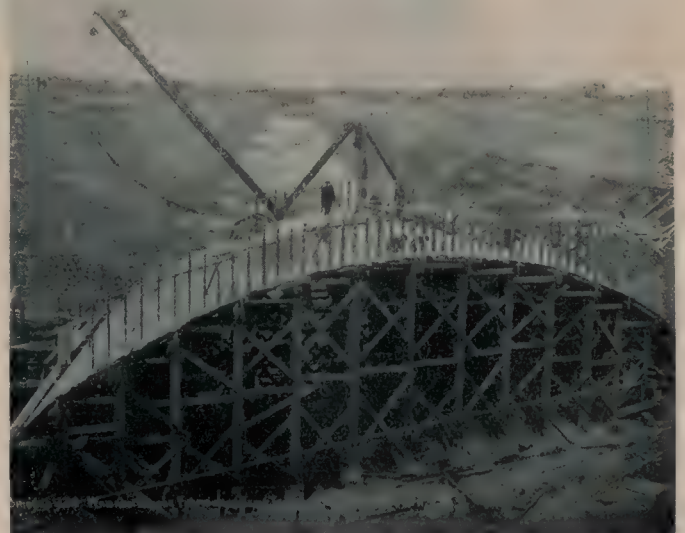
span of 800 feet. The excavated material is being disposed of along the north bank of the river. The width of the Welland River at the water line averages about 300 feet.

The Commission has purchased one hundred and fifty 20-yard Western airdump cars, each of 80,000 pounds capacity; also seven 40-ton steam locomotives and twelve 50-ton electric locomotives. The steam locomotives are switchers purchased from the Pennsylvania Railroad. The electric locomotives were built by the National Steel Car Company, Limited, of Hamilton, Ontario, six of them being constructed with General Electric equipment and six with Westinghouse equipment. Two pile-drivers are at work on the river section. There are three 40-ton and two 15-ton Bay City locomotive cranes for general utility work.

15,000,000 Cubic Yards of Excavation

It is estimated that 9,000,000 cubic yards of earth and 4,000,000 cubic yards of rock must be removed from the excavated section; and from the river section, 2,000,000 cubic yards of material, mostly earth.

At the present time the material which is being



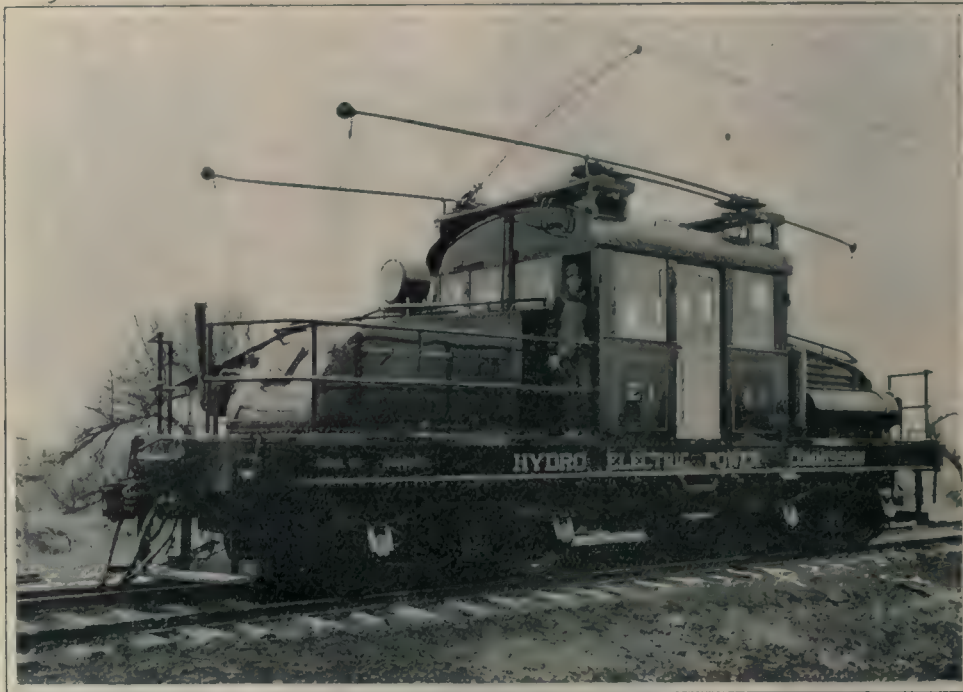
Centering for one of the concrete bridges over the Chippawa power canal

excavated from the Whirlpool sections is being used to fill the old Whirlpool gully, but the main dump, as already noted, will be at St. David's. A double-track railway line runs the full length of the canal from Montrose to the forebay, and a $2\frac{1}{2}$ mile span connects the main line with the St. David's dump.

There will be various other branches of the railway constructed from time to time as needed. A railway will probably be built from the power house to connect with the Michigan Central at Queenston to bring in the machinery and to take out the materials excavated from the power house substructure.

The railroad lines are all electrified, the trolley wires being offset on one side of the track, and carried in clamps devised by the Commission's line construction department. These clamps and the hangers which suspend them from the poles are all made up of standard material, and are so arranged that the temporary use of the material does not injure it.

Framed timber trestles are set alongside the dump and other temporary tracks to carry the trolley wire. These trestles are mounted on wheels or skids and can



One of the electric locomotives. Note the double trolley arrangement, two poles on each side

be removed readily by a locomotive crane when it is necessary to shift the track.

In the Whirlpool yards is located a large repair shop containing drills, shapers, planers, lathes, forges, steam-hammers and wood-working machines. The Commission has built about eighty buildings, including bunk houses, freight houses, offices, machine shop, storehouses, substation, etc.; also a number of buildings are used which were on various parcels of purchased property.

Gunite Buildings

Most of the buildings are of frame construction, but are being "gunited" on the outside over tar paper and wire mesh, using 1 to 3 mix of cement and sand. Sharp concrete sand is being used and the "gunite" applied with cement-guns. The substation, machine shop and all of the more important buildings have already been fireproofed in this manner, and it is the intention to "gunite" most of the other buildings. The bunkhouses are comfortably arranged on the cottage plan.

The crushing plant is located on the forebay. It is equipped with three secondary crushers of the gyratory type and one 84 in. x 60 in. Taylor jaw crusher which will have a minimum capacity of 2,000 cubic yards of crushed stone per day.

The rock excavation at the forebay is loaded into skips which are picked up by a locomotive crane and which dump into a bin. A belt conveyor carries the stone from the bin to the crushers and from thence by another conveyor to the cars.

There are four railway bridges to be constructed over the canal, one for the Niagara, St. Catharines and Toronto Railway (electric), one for the Wabash Railroad, one for the Michigan Central Railroad, and one for the Grand Trunk and Michigan Central Railroads.

These will be reinforced concrete arch bridges. There will also have to be constructed a number of highways and foot bridges to carry the various roads across the canal. In the concrete work to date, both Canada and St. Mary's cement have been used.

Several hydraulic models are being prepared at Dufferin Islands, near the Ontario Power Company's intake in the Niagara River. These models are based on designs prepared by the Commission and are for the purpose of studying the design of the intake at Hog Island. The design of the intake works will be based upon the results of these studies.

Construction Cheapened and Waste Prevented by Standardizing Housing Plans

By Norris E. Gibb*

NEARLY every municipality on this continent is claiming a shortage of workmen's houses. This branch of the building industry is one that requires the best possible results with the least expense, and in order to attain this object there is room for improvements on the before-war conditions.

If the houses for the working men were confined to, say, five styles, and those styles were standardized in regards to specifications, it would assist the contractor to speed up construction and also the supply man to assemble doors and frames, window frames and sash during any time that the factory was not crowded with orders. If the different contractors would use cost sheets of their labor, waste, and overhead expenses, in other words, organize a campaign of education as regards equipment, transportation, cost of work, etc., that would prevent waste and must surely cheapen construction.

*Contractor, Sarnia, Ont.

Cutting Down the Cost of Engineering in Building Design and Construction

Employ the Best of Engineers, Recognize the Fallacy of Free Engineering and Free Designs, Use Simple Methods and Work Out Details From the Start

By E. H. Darling, M. E., M. E. I. C.*

IN the broad sense in which the term "engineering" is used to-day there is hardly an item which enters into construction which does not have, at some stage or other, engineering thought expended upon it. The contractor, however, is not directly interested in the process by which his materials reach him, so this discussion will be limited to that field of engineering which has to do with the assembling of materials, first on paper as a design and second in the actual structure.

The first stage is not the only one that requires engineering skill. On every job there are always problems of an engineering nature to be solved, while a mind most ingenious in devising cost-saving methods will have its powers greatly increased by engineering assistance or, better still, by engineering training.

Contractor Without Engineering Assistance Takes a Chance

It is next to impossible for the contractor to-day to undertake work of any magnitude without engineering assistance. The fact that all large contracting firms have a staff of highly trained engineers is the best proof of this statement, if it needed any proof. In bidding on work of an engineering nature, a contractor without engineering knowledge or assistance is always taking a big chance. Only an engineer can appreciate an engineer's drawing and avoid pitfalls in taking off quantities. Besides, there are many savings to be effected in construction. Some designs from architects offices are got out by draftsmen with limited engineering experience and the contractor's engineer may, at times, be able to cut the cost of details without detriment to the finished building.

Best Engineer is Cheapest in the End

The duty of engineering, however, is not always to save money and a contractor will often have apparent cause to complain that his engineer is "too cautious" or "too conservative," forgetting that engineering responsibility pulls two ways—first in the elimination of unnecessary waste and, second, in the prevention of accidents and inefficient construction. The most extravagant designer, however, is (all else being equal), the man with the least experience. Experience gives confidence, (the confidence of knowledge, not of ignorance), and permits closer figuring while the inexperienced man must always be sure he is on the safe side. The best engineer is, therefore, the cheaper, and this is the first step toward reducing the cost of engineering.

An engineering staff naturally enlarges the field of business for a contractor but, in addition to construction work, some firms also undertake the designing of buildings, or other structures and this system is often quite satisfactory, particularly if the contractor specializes on some one or more class of work. However, it depends, as do all other undertakings, on the calibre

of the men behind it. It requires a well balanced engineering staff or else a man of exceedingly broad experience to be able to design successfully in many different branches of engineering and in addition combine the various works into an architectural or industrial whole.

"Free Engineering" Proves Expensive

Furthermore the mental attitude of the contractor's engineer toward the work cannot possibly be the same as if he were directly employed by and responsible to the owner, nor has he the same free hand to act according to his best judgment for in all business organizations engineering efficiency is too often subordinated. But when this same practice is adopted by manufacturing contractors and supply firms who hold out the line of "free engineering" simply for the purpose of eliminating competition and to sell their products at fancy prices, then there is danger of it becoming an open channel for wasting money, rather than a leak, for of all engineering, "free engineering" is likely to prove the most expensive.

Suppose, by way of illustration, that a consulting engineer, or an architect, is entrusted with a piece of work which is beyond his ability and that of his staff to design. It may be structural steel, reinforced concrete, electric wiring, a heating or sanitary system or some other highly specialized trade. He has a choice of at least three methods of handling it.

- (1) He may require bidders to submit their own designs.
- (2) He may take advantage of the kind offer of a contractor to make him a design for nothing.
- (3) He may employ an independent expert to design the work.

Wasteful Methods of Obtaining Designs

The objectionable features of the first two methods scarcely need pointing out. While there are exceptional pieces of manufactured work for which the first method of calling for tenders is the only fair one, yet for all work met with in general contracting, such as the trades mentioned above, it is always unfair to the contractor. In the first place any one who falls back on this method is never competent to draw up definite enough specifications to insure uniform bids and there is nothing to prevent a dishonest bidder from skinning his design. It is not unusual to see very inferior work accepted under most rigid specifications—the specifications having been picked up somewhere and used without an understanding of its fine points. In the second place it is quite unfair to ask a bidder to go to a great expense in preparing a design on the chance of securing the contract. The cost of tendering at best is a heavy one for the contractor to carry. He must either write it off as a loss or else handicap himself by loading up his overhead charges to cover it. But whether it finally comes out of the owner or the contractor, it is an economic waste to require the prepara-

*Consulting engineer, Hamilton, Ont.

tion of half a dozen or more designs to save the engineer or architect the cost of one. This is the second and very obvious item by which the cost of engineering should be reduced.

Free Designs Obligate Architect

If, on the other hand, our imaginary engineer or architect adopts the second method of handling his unfamiliar job and accepts a free design from a contractor or a manufacturer, he must either tie up to that firm and specify their products, to an unfair exclusion of all others, or pass off the design as his own with the tacit understanding that the donor will be specially favored in some way. Even when done openly, such methods are seldom to the best interest of the owner, but when done as it sometimes is done, it is out and out dishonest—a betrayal of trust. Instead of seeing that his clients gets value for his money, he not only allows him to be overcharged but accepts payments for service he never rendered and in addition draws his commission on the increased cost of the work.

Nor is this extra cost an insignificant item. The writer has sometimes effected a saving of over fifteen per cent. by having a properly prepared design instead of "leaving it to the contractor." This saving is made by economy in design and by the competition obtained, which is all the keener because in a clearcut proposition all uncertainties are eliminated.

However, in the way of adoption of the third method, that is the employing of an independent expert to make the design, is the question of who is to pay the expert. The large engineering and architectural firms have met the difficulty by employing specialists for all these lines on their staffs and they give their clients all the advantage of them without extra charge. This makes it difficult for the smaller firms to do other than pay for the service of experts required. On the other hand, the writer believes that there are many cases where the work is so evidently beyond the range of the engineer or architect and the saving to be effected can so clearly be shown that the owner would be willing to pay at least part of the additional fees.

Simple Methods Serve the Purpose at Less Cost

Another important leak in building construction which is really only another phase of the above is sometimes to be found in the use of expensive patented articles or materials in place of cheaper and simpler ones which would answer the purpose in all respects. Occasionally a real economical device is introduced but even then, unless it is revolutionary in principle, it is usually made to carry all it will stand till the patent rights expire or until rival methods force a reduction in price. Examples might be taken from any trade but as an illustration of general interest, the history of concrete reinforcing may be referred to. In the early days of this construction there were many patented systems introduced; any one of which was theoretically good if not ideal, and great advantages were claimed over the simpler methods. It could be shown that they made a saving of point naught something per cent. in steel—that they saved so many cents per ton in placing and that there was less possibility of making an error in the work of placing, etc., etc. All these are important items and when reinforced concrete was a new thing, engineers and architects were wise to take advantage of the safeguards which special systems offered together with the "free engineering," as at that time expert designers were very scarce. But as a re-

sult of years of study and experimental research and practical experience, the fact has gradually been established that, for all ordinary uses at least, plain materials which can be bought at base prices in the open market can, if properly designed, be made as efficient as the more expensive priced reinforcing; that the development of trained foremen and skilled workmen has greatly reduced the cost of placing while more thorough inspection methods have eliminated the danger from errors in placing. Under these conditions the highly manufactured material with its burden of royalties and "free engineering" unchecked by wholesome competition is usually found to be the most expensive in the end.

All such needless expense is waste which is chargeable to inefficient engineering and this item is sometimes a very large one. In certain classes of building construction the writer has found it to amount to as much as twenty-five per cent. of the cost of materials.

Work Out Details at the Start

It will be conceded as a general principle in construction work, that the more completely a design is worked out in detail at the start, the less will be the final cost of the structure. This detail work must be done at some stage of the construction. But how often minor details, as they are considered, are left by the designer until the building is well under way or nearing completion and then only to find that an immense amount of expense might have been saved had they been considered earlier. The spectacular method of starting the foundations of a building before the plan for the first floor is laid out may be justifiable under some circumstances but is often the cause of much waste and inefficient construction.

Again, if complete details were available at the time the contractor takes off his estimate, how much closer he could bid and how many dollars it would save him in the allowance he must make for contingencies. And how much trouble it would save him and the owner over the "bill for extras" and how many law suits it would prevent.

Just to what point this principle of detailing should be carried out by the engineer or architect it is not possible to definitely fix. For instance, the structural steel contractor always prefers to make his own shop drawings because only a draftsman with long years of experience and one who is familiar with the particular methods of his shop can make a satisfactory drawing for him. Nevertheless minor changes in detail and marks, notes, etc., can be added to a drawing after a tender has been accepted and the writer has found it very advantageous, under certain circumstances, to prepare complete shop drawings of steel work on which to call for tenders. This insures economy in design, closer estimating and a great saving in time which is usually consumed in sending contractor's shop drawings back and forth for correction and approval. While such a method is not always practicable, still every step in that direction will relieve the contractor of just so much responsibility and cut down his engineering costs.

Expense in Tendering

Reference has been made above to the unreasonable expense to which contractors are very often put in tendering on work, but even at best it is a wasteful system. In theory the employment of "quantity surveyors" as is done in the Old Country would effect a great saving but most of the contractors who handle

the class of work we have in mind have an engineering staff available for estimating purposes. This gives him a lead over smaller contractors which he is not at all willing to give up. Besides, every office has a sort of personal equation in estimating and have not the same confidence in the quantities taken off by an outsider. The smaller contractors, however, often employ an independent engineer to assist them in this work and when several combine for this purpose the cost becomes a very small item.

It would seem to the writer that if the drawings and specifications prepared by the engineer or architect employed by the owner were made full and complete, with at least a reasonable amount of detail and if these were accompanied by a guaranteed estimate of quantities of the main items of materials such as is often given with engineering work, we will have reached as high a standard of economy as can be expected at present and will have cut the ultimate cost of engineering to its lowest limit.

Reducing Costs with Standard Buildings

For Industrial Purposes, Economy and Speed are Secured
by Adaptable Steel Units of Standardized Design

By John M. Taylor*

DEVELOPMENTS during the month of May have made evident the fact that the long anticipated drop in building costs has been "deleted by the censor" and will not form a part of the building programme this year. On the contrary, lumber prices have jumped upward, steel is threatening to follow, and virtually all other building material costs have been declared either stable or on the verge of a rise. There can be no doubt that the bottom of the market has been touched, and that for a year or two to come any change in costs is more likely to be upward than downward.

Speaking relatively, and in comparison with costs of all commodities, building costs occupy about the same position as always. The reduced purchasing power of the dollar applies equally to all things. If business transactions could be reduced to terms of barter, the purchasing power of a hundred bushels of wheat would be found to be three-and-one-half times as great as it was twenty years ago, and the same ratio applies in the cases of nearly all other raw materials.

Economy Secured by Standard Buildings

All things considered, a manufacturer who contemplates the construction of a new building will certainly find himself obliged to pay a cost much higher in dollar figures than the cost of a few years ago, but no higher in actual relative cost. If these figures are to be reduced to any appreciable extent, it must be through economy in labor costs and by other means wholly dependent on the efficiency of the builder he chooses for the work. One of the most successful means by which high quality workmanship can be combined with the maximum economy is through the use of standard industrial buildings.

Standard buildings for industrial purposes form a class of construction with which manufacturers in general are just becoming acquainted. Originated a few years ago by a building engineer in Ohio, they were coming into prominence through the east and middle west at the time when the government placed its ban on all construction intended for purposes other than war work.

The construction division of the U. S. army promptly recognized the points of advantage in this type of building, with the result that the several companies equipped to erect standard industrial buildings were pressed into service on war construction. Almost im-

mediately standard buildings began to spring up in various parts of the country, to be used as munitions factories, warehouses, arsenals and for numerous other purposes. This continued throughout the war, and it was not until some time after the armistice had been signed that standard buildings again became available for construction by private manufacturers.

Substantial and Permanent

A standard industrial building is by no means a portable or temporary structure. When completed, it is thoroughly substantial and permanent. It is standard because it has been designed to be erected in standard units. Its steel and timbers are of standard dimensions, which are fabricated and cut in large quantities and kept in stock by the construction companies ready for immediate shipment and use. In size, these buildings vary from the comparatively inexpensive "sawtooth" to massive reinforced concrete structures suitable for the heaviest kind of manufacturing. They are open to a great amount of individual treatment which allows them to be adapted to the requirements of the manufacturer and when desired, gives each building a distinctive touch which prevents it from having a stock pattern appearance. As an additional advantage, when the manufacturer's business expands, he need only remove a side or end wall and add a few additional units in order to have all the space he needs under one roof.

Economy is a marked feature of standard building construction. Buying their materials in large quantities, the construction companies which specialize in this type of building are able to obtain and give better figures than can be obtained in many other building fields. Furthermore, the men in charge of their construction crews are thoroughly familiar with every detail of the work which enables them to avoid costly delays and errors. Labor-saving machinery and equipment is also used wherever practicable, which results in further saving, for labor is an important item in building costs at present. When desired, speed can be made a strong feature in standard building construction, but this is avoided by the builders whenever possible, because excessive speed almost inevitably increases cost and lowers the quality of workmanship.

For light manufacturing it is doubtful if any type of building will surpass the standard or more effectively meet the owner's desires in the way of quality and economy.

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Open Price System of Exchanging Bids Tends to Eliminate Discrepancies in Tendering

Scheme, Simple in Operation, Puts Bidding Above Board and Paves the Way for More Judicious and Reasonable Figuring

By the Secretary of the Open Price Committee, Toronto Electrical Contractors' Association

THE Open Price System has its basis in the modern conception of business that an honest man gains nothing by concealment and a crook's profit is only temporary at best. Jerome Eddy, who "invented" the idea and has written a book about it, first attempted to get together with others in his line and fix prices. This worked out so badly that Mr. Eddy withdrew from the "combine." The next morning, however, his competitors were surprised to find in their morning mails, copies of all Mr. Eddy's tenders given the day before on various pieces of work. An accompanying letter advised that this would be his daily course in future. His competitors thought it over and decided to reciprocate and so began the first "Open Price" exchange.

Mr. Eddy argued that if he was right in his figures and estimates he had nothing to conceal and if he was wrong he could not afford to conceal.

This idea of Mr. Eddy's has appealed very strongly wherever it has been explained and there are many organizations in the United States where prices are regularly exchanged. In New York, for example, there are a number of manufacturers', jobbers' and contractors' associations operating on this plan and it has been found satisfactory to handle all these organizations through the same office. In Toronto the idea was taken up a year ago by the electrical contractors' association and, as a result of its successful operation, sub-contractors in other lines are now considering it. In a modified form the lumber retailers and jobbers have been operating the same system for some time.

The Value of the Open Price Plan

The weak place in most contractor's organizations is the estimating department. No further proof of this statement is needed than may be found in a comparison of the figures tendered on any job of fair size. Quite often there is a discrepancy of fifty per cent.; not unfrequently 100 per cent. It rarely happens that out of a half a dozen tenders more than two, at most three, are approximately the same. Of course, specifications are frequently incomplete or ambiguous, but even in cases where the requirements are laid down in accurate detail the discrepancy is ridiculously high. To give a concrete example: Four electrical contractors in Toronto recently submitted tenders on a good sized job and exchanged figures through the Open Price Secretary. The specifications were as definite as they could well be and yet there was a variation in figures all the way from \$14,000 to \$23,000. After the contract had been let—to the lowest tenderer—these four contractors got together to try and find out wherein the fault lay. It is perhaps a sufficient comment on the situation to say that, after spending a whole afternoon going over the specifications with his three competitors, the highest bidder remarked that he would not accept one dollar less than his original tender if the job were now offered him. The question

naturally arises—what will happen to the firm that got the contract. Time alone will tell, but we suggest the reply of Lloyd George when early in the war he was asked how the situation was shaping—"Hope for the best but prepare for the worst." Whatever happens—and we hope for the best—these four contractors will have gained a tremendous amount of valuable information and herein lies the first and biggest advantage of the Open Price Plan.

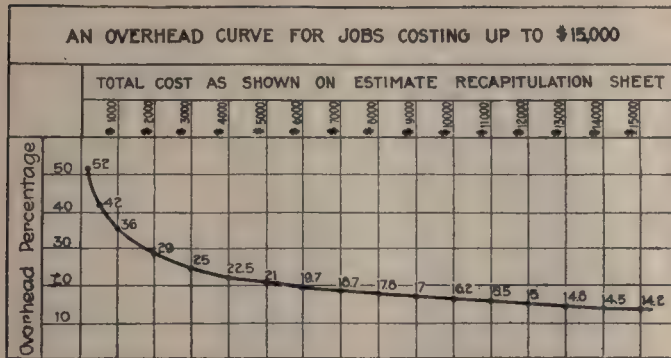
Contractors See Each Other in a True Light

There are other advantages, however, which are scarcely less important. One of these is that the contractors learn to see one another in their true light and estimate one another at their proper value. The Open Price System becomes a splendid test of a man's honesty, but more than that, it places him in a position where he immediately loses the respect of his fellow contractors if he is dishonest. This latter fact is a real moral support to many a man who might, if he were not likely to be found out, become a party, under pressure of keen competition, to practices that he would not even himself approve in his more deliberate moments. Practically all men want to be straightforward and also, doubtless, think they are. The explanation seems to be that some of us are morally cross-eyed. Herein then lies another advantage of the Open Price idea—that we have to live up to our competitor's idea of business morality in addition to satisfying our own.

Then again there is the protection this plan affords the contractors against the (sometimes) unscrupulous architect—or to put it a nicer way—the architect who is overzealous in the interest of his client. Such things have happened as that an architect has said to the lowest bidder: "I'd like to give you this job only—well, you're a little high." The architect knew you were the lowest bidder but you yourself didn't and doubtless have fallen for the bait. If you knew your competitor's prices you could defend yourself against such practices.

Operation is Simple

In actual operation the Open Price System, as generally practiced, is very simple. You first establish a "clearing house" in charge of an impartial secretary. All tenders are submitted to him. If there are two tenders on the same job from contractors A and B, a copy of A's tender is immediately sent by the secretary to B and a copy of B's tender to A. For a larger number of tenders the same practice is followed, i.e. each contractor gets a copy of the figures submitted by each of his competitors. No contractor gets any information of any kind until he submits copy of bona fide tender to the secretary. It is usual to allow any contractor to revise his tender but he must immediately advise the secretary of his new figure which is passed along to the contractors bidding on the job. However,



Curve showing overhead for jobs \$200 to \$15,000

in actual practice the revision of tenders is frowned down upon, contractors generally agreeing to stand by their original figure or withdraw from the contest altogether. As the system of estimating becomes more and more standardized and stabilized and the discrepancy in figures gradually narrows down, the necessity for revision or withdrawal will also naturally disappear.

As ordinarily practiced there is no obligation on any contractor to submit his price on any job to the secretary. He himself is the loser in that case because he has no knowledge of what the others are doing. The idea underlying the successful working of the plan, is

that there shall be no coercion on any contractor. It is a campaign of education. If the advantages of the system will not lead a contractor to adopt it, there is no idea of forcing him and no object to be gained in attempting force.

Gauging Overhead Charges

Regarding the first point raised above, viz., the reduction of big discrepancies in bids submitted by different contractors on the same job, it may be of interest to note that so far as the experience of the Toronto electrical contractors goes, a great difference of opinion exists as to the proper percentage to charge for overhead. There are two clearly defined viewpoints: the first, that the same percentage should be charged for all jobs; the second, that the percentage should be varied—the smaller the job the bigger the overhead percentage. There seems little doubt that the latter idea will prevail and become standard for the association. Over in Chicago, where they have gone into the question of estimating so thoroughly that they have formed an estimator's association, figures regarding overhead have been collected over a period of years and a regular schedule of overhead charges has been drawn up. Recently the association published a curve showing the results of this investigation in graphic form. This curve, we show above for the sake of any bearing it may have on other contractor's problems.

Thinking as an Antidote for High Wages

Much of Blame for High Costs Lies in Inability of Management to Do Its Work—
Only Hope of Low Costs is Increased Production Fostered by Proper Management

By M. C. Tuttle*

UNDER peace conditions there are three general requirements for any product, and their order is: 1, cost; 2, quality; 3, speed. Under war conditions the order of these requirements changed to: 1, speed; 2, quality; 3, cost.

In the care of every one of the concerns for whom we built during the war period the management was under a tremendous load. It commonly had the problem of switching from a peace-time product of standard articles to a war-time product of articles that were often strange, not only to the management but to the workmen. Neither the management nor the workmen understood what constituted a proper day's work, and neither knew exactly the best way to produce these articles. Under the conditions, they were forced to start production without full information and commonly without full knowledge of production standards. It was hoped that once they got the production started they would have the opportunity to study the best methods of production and to establish shop standards as to a reasonable day's output. In some cases they actually succeeded in doing this, with the result that their costs came down and they approximated the same output per man that they would have obtained before the war. With the same output and with higher wages, the cost was, of course, more.

New Problems Swamped Management

More commonly the flood of new problems which swamped the management prevented it from giving careful attention to the details of manufacture. An

overworked manager thanked God that the factory was producing something and stole as much time as possible for instructing and encouraging his organization. He knew it would be months before he could really get into the details enough to straighten out the refinements of the operations. Some departments ran well and some badly, depending upon the intelligence and the spirit of the help and upon the ability of the supervisors. If the output of the different departments did not balance, then the quickest remedy was to throw in more men and boost that part of the job through by brute strength.

None of the managers will admit that this is exactly what happened, but it is near enough to be typical of many cases. It is impossible to put through three and four times the normal volume of business under the direction of a management that is losing its best men into the army and government war activities, and still carry on this increased volume with the refinement and care given a job during peace times.

Slacking Off on Output

To blame labor for this situation is to see but half the problem. The workmen were struggling with new problems as difficult for them as the problems of management were for it. The men saw many parts of the work handled carelessly. They saw great numbers of men put in to overcome obstacles which, under old conditions, would have been removed by careful thought and planning. Not knowing the perplexities and overload of the management, the men naturally enough concluded that the management was not wor-

*General manager, Aberthaw Construction Co., Boston.

rying about costs, and forthwith slacked off on their output.

In factories engaged on a standardized output there was slacking off because the men knew that they could get employment elsewhere at any time that they cared to leave. They eased off a little, depending on the ability of the management and on the good-will which it had created; but the slacking off was much worse in the factories which were upset by new processes and new operations.

With the return of peace, manufacturers are commonly going back to the operations which they understand and the men are returning to work on which they have been trained. There is not in the mind of any of these workmen the sure belief that he can get a job next door if he leaves his work. The management is not overloaded nor troubled by new and unusual conditions and the reversal to peace requirements has brought the element of cost first in the order of importance. Under these conditions, when obstacles arise the management first studies these obstacles to determine how they can be best overcome. More men are not thrown into the operation until after it is determined that more men are actually necessary. Less and less the men see inefficient help piled in to overcome obstacles, and the management is commonly thinking out methods of handling the work most conveniently.

It is perfectly well understood that the basic rate of wages is not at all likely to come down—that the only hope of low costs lies in increased production. This increased production will come through good shop methods, to be sure, but primarily it will come through the wish of the workmen to produce a fair

day's work. President Hopkins, of Dartmouth College, has explained clearly that the waste within the control of the individual workman is so great that until his mind is set toward proper production, attempts to systematize and arrange processes are too unimportant to deserve consideration. The problem of the employer to-day is fundamentally the problem of obtaining the good-will of his workmen, and by good-will I mean not alone their personal regard, but their willingness to produce a reasonable day's output for him under the conditions in which the work is done.

I believe that the best managements are laying less emphasis upon the fear which their workmen may have of losing their jobs, but more upon the good-will which exists and grows under fair treatment and firm, kindly discipline.

Many a management that is complaining of high costs knows very well that much of the blame for the past high costs lay in the inability of that management to do its work, which work precedes that done by the men. It is only axiomatic to say that given the same individual workmen, a good management with ample time to perform its functions will produce more economical results than a poorer management or a management that has not time to do its work. With the return of peace the opportunity for the management to properly perform its functions has again returned, and with it comes the opportunity to make economies not possible before. Cost, quality and speed are largely affected by the management. In many businesses there is, indeed, a large element of cost well within the management's control. There is the chance to do the thinking for which there was all too little time during the war.

Responsibility for Housing Clearly Recognized

Councils and Governments See How Improper and Inadequate Housing Impairs the Efficiency of Labor — Workers Shun Private Schemes

By Sir John Willison*

IN the industrial centres throughout Ontario there is a great scarcity of houses. Rentals are excessive in many communities and in many no accommodation is available. In hundreds of cases in Toronto, two or three families occupy a single dwelling. There are many houses condemned as unfit for habitation, from which the occupants cannot be ejected because there is no other accommodation. Builders are reluctant to construct inexpensive houses and very often require heavier cash payments than workmen can afford.

It is held that rent should not exceed 20 per cent. of wages, but in many industrial communities a higher percentage is exacted. It is argued that employers have a degree of responsibility for the housing of workmen and in not a few cases, the responsibility is acknowledged. But many workmen do not care to be the tenants of employers or to purchase from employers. There is a feeling that their freedom is affected or that wages are lower because houses are provided. For this attitude there is probably no general justification, but that it exists must be admitted. With the better relations between employers and employed that seem certain to develop, notwithstanding the unrest and conflict of the moment, this antagonism should disappear and housing become the com-

mon and intimate concern of all the partners in industrial enterprise. In the meantime the appropriations in the Dominion and the provinces for inexpensive houses, should produce good results.

There is a great advantage in the low rate of interest on the government loans with the prevailing high prices for labor and materials. It is doubtful, if wages will ever fall in any such degree as may be expected, and probably for some time the demand will steady the prices of building supplies. Until the cost of living declines wages will be maintained in some comparative reasonable relation. Even aside from the exceptional situation, the responsibility of councils and governments for the housing of the people becomes more clearly recognized. Improper and inadequate housing impairs the efficiency of labor, produces deplorable moral and physical consequences and lowers the standards of citizenship. In Ontario all housing projects assisted from the State fund will be approved by the government, and doubtless other provinces will do likewise. This approval will cover the character of the houses, the layout of the land and the provisions for sanitation, open spaces and playgrounds. The result should be to improve materially the conditions under which many thousands of the people will live and to establish standards which will be of great moral and national value for the future.

*President, Canadian Reconstruction Association.

Houses for Halifax Reconstruction Built of Granite-Face Concrete Blocks

Hydro-Stone Units with Natural Stone Appearance Make Hollow Walls—Layout and Operation of Block Plant

EFFICIENCY in house building is exceptionally well exemplified in the extensive and important schemes developed for the reconstruction of devastated Halifax. It will be remembered that on the morning of December 6th, 1917, the explosion of 4,000 tons of T.N.T. on the French ship "Mont Blanc," after she had been rammed by the Belgian relief ship "Imo," resulted in the tragic devastation and almost complete annihilation of a large portion of Halifax. The consequences in material damage, loss of life and suffering are too well known to need recounting. Suffice it to say that, from the emergency measures taken to afford temporary relief, there grew up an organized system for the rehabilitation of the tens of thousands of homeless citizens and the fostering of a greater and newer Halifax.

The stupendous task of rebuilding the city devolved upon the Halifax Relief Commission, which was given very wide legislative powers to administer the investment of the millions of dollars provided for relief purposes. A free hand was provided to carry out any plans for the re-planning and laying out of the devastated areas that the commission deemed fit. The work of the commission was obviously centered around the provision of permanent housing accommodation and to cope with the two-fold nature of the problem—planning and building—two departmental divisions were organized.

The reconstruction department of the Commission's work came under the direct supervision of Col. R. S. Low as general manager, until he was succeeded by Mr. George Archibald. The Architectural department was headed by Mr. A. G. Ross of Ross and Macdonald, architects of Montreal. He, in consultation with Mr. Thomas Adams, town planning adviser to the Dominion Government, developed a town plan for the reconstructed city and prepared the drawings for the dwellings that were to replace the thousands of wrecked and devastated homes.

Planned in Accordance with Best Ideas

Opportunity was taken of the disaster to plan the city in accordance with the most recent ideas developed by town planning experts in Canada, United States and European countries. The faults of the previous layout were rectified and new ideas developed, destined to provide the most economically beneficial results to the citizens, individually and collectively. In the replanning of the devastated area, suitable sites were set aside for churches, schools, parks and playgrounds. Houses were designed to be erected of most modern construction and to provide up-to-date conveniences so as to afford permanent housing of the most desirable character.

The architects made a careful comparative study of the available building materials with a view to selecting the most suitable from the point of view of economy and construction as well as of durability

considering the exterior treatment of the houses, it was found that the cheapest would be wood, either clap boards or shingles, the next cheapest, some form of pre-cast concrete block, the next stucco, and the most expensive brick or concrete formed in place. As a fire-proof material was desired, it was decided to make extensive use of a special concrete block called "hydro-stone" and to manufacture this block at a plant already established where a plentiful supply of sand and gravel was available.

Special Concrete Blocks Selected

The hydro-stone units are concrete blocks, manufactured by special machinery under great pressure. A comparatively wet mix of concrete can, therefore, be used, which, when properly proportioned to suit the aggregate, produces a dense block practically non-absorbent. In material the block requires just half that needed for a solid eight-inch wall and form work is entirely eliminated. The weight of the blocks is about 80 lbs., so that they can be set without the use of derricks. The labor cost of setting is somewhat less than for brick work.

The feature of the hydro-stone units is that a facing of crushed granite, marble, quartz, etc., can be applied in the process of manufacture to give the block an aesthetic appearance, dispensing with stucco, as is necessary on a poured concrete wall. Crushed granite is used on the Halifax houses and where, for architectural variation, stucco treatment is desired, this is applied directly to rough hydro-stone blocks, manufactured without special facing.

In certain portions of the city, houses of wood, treated on the exterior with shingles on clapboards, are constructed, but this article concerns itself only with the concrete block houses as mentioned. This type of residence will be entirely used in those parts of the city where fire resistance is a matter of first importance and where a more permanent development is desirable.

Group Development

The largest development of concrete block houses is a group scheme on the area between Gottingen and North Creighton streets. The development at this point comprises 326 dwellings in terraces, containing some four and some six dwellings each, with a few two-flat houses. All of these buildings, totalling 88, have hydro-stone exterior walls with slate roofs and interior of wood and plaster. The dwellings contain from four to six rooms each with bath room, electric light, etc. They are arranged in short rows on each side of a series of large grass plots which serve as play grounds. Between each pair of grass plots service lanes were arranged, wide enough to allow the passage of tradesmen's wagons. In each of these lanes were placed the water and sewer services for the adjoining houses. In front of the rows of houses and between them and the grass plots were arranged sidewalks and roadways connecting Gottingen and North

Creighton streets, wide enough to permit one-way traffic only.

Varied Plan and Exterior Treatment

The buildings containing four dwellings each are of six types, varying somewhat in plan and differing from each other as to exterior treatment also, some having concrete block exteriors to roof level, some with stucco and half timber treatment on the second storey, some with hipped roofs, some with simple pitch roofs and gables. In this way it was found possible to have, with only three variations in plan, twenty-

four in general it may be said that the first floor consists of living and dining rooms, kitchen, pantry or storeroom, with three to five bedrooms on the second storey with a bath room in every case. With regard to ventilation, every room has at least one window opening directly to the outer air. The houses have porches. Special attention has been given to the plumbing, while heating will be by hot air.

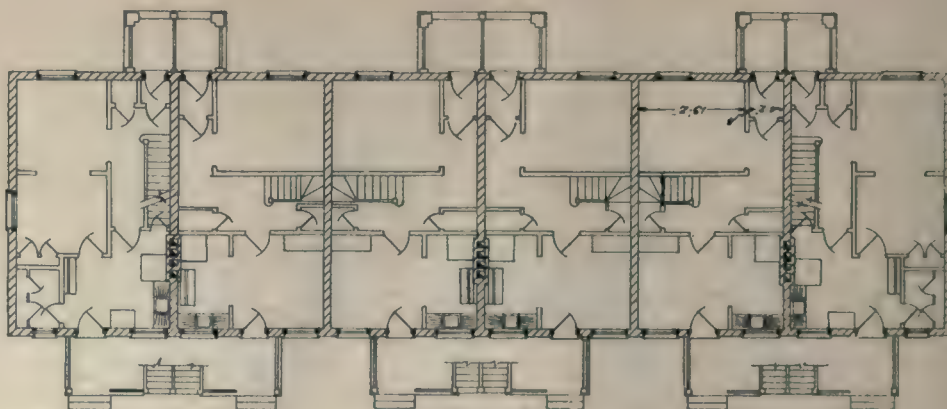
To afford some idea of the method by which hydro stone blocks are manufactured, we give a description of the plant in which these were turned out.

The material selected for the exterior of the group

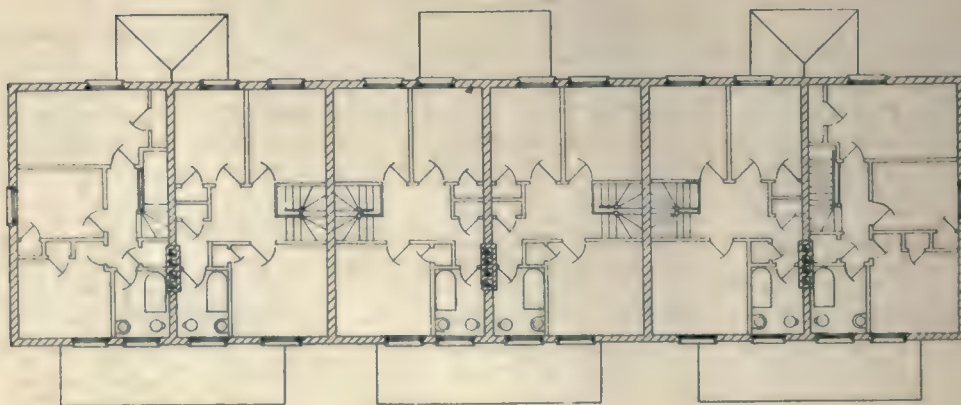


Front elevation of a six-family house of hydro-stone and stucco

Ground floor plan of six-family hydro-stone and stucco house



Second floor plan, six-family hydro-stone and stucco house

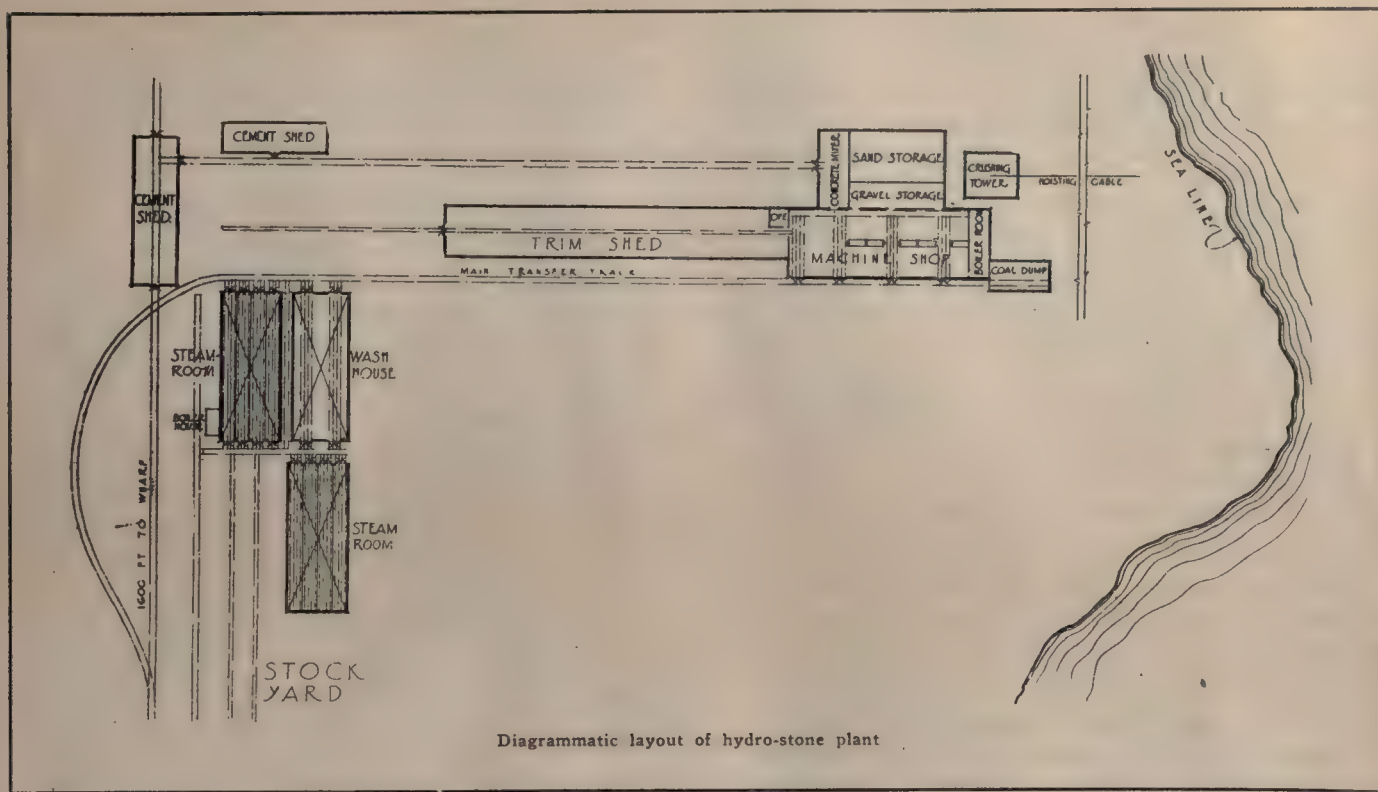


ty-four apartments, each differing one from the other sufficiently to give it a certain individuality.

Thirty-seven buildings or 148 houses of this type are comprised in the entire development of 326 dwellings. The remainder of the development is composed of buildings containing six dwellings each and some containing two dwellings each. The buildings containing six dwellings each, numbering 19, are of five different types, differing both as to arrangement of plan and as to treatment of elevation.

The plans provide for houses of various sizes, but

development, as previously mentioned, was "hydro-stone," a building unit of properly proportioned concrete, consisting of gravel or crushed stone, sand and Portland cement, with sufficient water to crystallize it thoroughly. In the making, each unit is subjected to 150,000 lbs. pressure, resulting in a material that has an extremely low percentage of absorption. The feature of the hydro-stone units is the possibility of facing them with crushed granite so as to produce an effect hardly distinguishable from that which would be produced by the natural stone. This was done in the



Halifax houses except in blocks over which stucco was applied. Each unit is "T" shaped in section and measures 9 in. by 24 in. on the face.

The plant of the Nova Scotia Construction Company, Limited, at Southeast Passage near Halifax, was used for the manufacture of the blocks. The large plant for the digging, crushing, screening and washing of gravel had already been established for the manufacture of reinforced concrete piles and the equipment was such as to lend itself admirably to such intensive production of hydro-stone as was demanded by the exigencies of the situation. Large and plentiful supplies of sand and gravel were available in close proximity to the Nova Scotia Construction Company's plant. They were obtained from almost unlimited deposits back of the sea beach. In order that the salt water might not encroach upon the pit, a natural sea-wall or dyke was always maintained between the sea and the place where the gravel was being dug; the material being taken from the bottom of a large pool of fresh water.

Cement, both gray and white, was received in cars on the pier at Halifax, together with the crushed granite and white sand. These materials were taken to the plant on scows, a covered scow being used for the transportation of cement.

Crushing Unit

The plant consists of a tower containing crushers and screeners to the top of which the gravel is carried in a bucket travelling on a cable, after having been thoroughly washed by fresh water. The crushing, screening and washing tower is maintained on wheels on tracks, so as to be moved as old deposits are exhausted. Day and night operation of this unit can be carried out, if necessary, to obtain the required supply for the machines. The crushed, screened and washed material is supplied to storage bins beside the mixer plant.

The mixer building containing two 1 yard mixers (one for spare) is located adjacent to the tower. Next

to this building is a large machine shop and boiler house, served by transfer tracks connecting it with the main industrial track which carries the finished products to the steam room, where they are cured.

The building in which the blocks are made contains five machine units for the manufacture of the standard faced blocks. A large trim shop, located at one end, is employed for the manufacture of special



Storage yards, showing hydro-stone blocks awaiting shipment

pieces of unusual size, such as lintels, sills, coping blocks, which are cast by hand in wooden moulds, manufactured as required in an adjacent pattern shop.

Blocks Made Under High Pressure

The machine for the manufacture of hydro-stone, developed by the Hydro-Stone Co., Chicago, is a double-end or single-end press, applying pressure

through heavy compound toggles, the operation of which is figured to apply 150,000 lbs. pressure against the face of the blocks while in the mould. This pressure compacts the concrete, squeezes out any surplus water, fills up the voids and forms on the block a dense face and square sharp edges. The mould boxes are made stiff and strong enough to withstand the heavy pressure. Special cores are employed for making corner, half, jamb, double, web blocks and veneer slabs. Fillers used with these cores vary the dimensions of the face of the block and thickness to suit the requirements. Two double end machines and one single machine are employed, with a total output of 3,500 to 4,000 blocks per day.

A fairly dry mix is used, the proportions having been determined after careful investigations of the sand and stone available at the plant. For belt courses, water table courses, etc., bevelled edges were formed by the use of special steel facing plates.

Granite Facing is Special Feature

The granite facing is easily handled as the blocks are made face up and released from the mould face down. The mould box is filled with an ordinary concrete mixture to within $\frac{3}{8}$ in. of the top. Mixed facing material is then applied immediately.

Upon the application of pressure a thorough bond is secured between the facing and body of the block. A pallet of 26 gauge galvanized iron of the same size as the face of the block is used in removing the blocks from the mould, this pallet being supported on a wooden pallet of the same size, built from $\frac{7}{8}$ in. pine. The block is received from the mould directly on the galvanized iron pallet and remains there through the subsequent operations until it is hard enough to be removed and washed about 24 hours later.

Washing and Curing

Facing material is crushed granite used with white cement and white sand in order to obtain the full effect of the granite. The crushed granite and white sand are delivered at the plant in bags and placed in bins adjacent to the machine. The facing material is mixed by hand.

After the block comes from the machine it is placed on a rack which is mounted on a rack car, one of which stands directly behind each machine at all times. As soon as the rack car is filled it is pushed on to a flat, transfer car standing on the industrial track, which car is taken to the curing room and later to the washing shed. On occasions, when rapid hardening is desired the blocks are taken to the washing shed before being cured.

The washing shed is provided with a plentiful water supply and small revolving tables on which the blocks are placed, one by one, after being removed from the pallets, to be sprayed and rubbed with fibre brushes, so as to remove any film of cement which may have formed on the granite surface. To remove stains or film, which do not readily yield to the water, a small amount of diluted muriatic acid is occasionally employed. In this department the metal pallets are also carefully cleaned and straightened, while the wooden pallets are carefully examined for defects of any kind, before being returned to the machine shop for re-use.

After the blocks are thoroughly washed they are again placed on the cars and transferred to the steam rooms. These are served from a special boiler house. Each of the eight rooms is just wide enough to re-

ceive two trains of rack cars entering at one end and leaving at the other, so that passage is continuous. When a train of rack cars is pushed into the room and the doors closed, the steam is turned on until the blocks are deemed to be sufficiently cured, when the cars are then transferred to the storage yard.

Shipment of Blocks

Several hundred thousand blocks will be stored in the yard, which is served by tracks connecting it with both the steam rooms and the wharf. Blocks are loaded in wooden skips containing about 70 blocks each, which are loaded on freight cars and taken to the pier where the skips are transferred to scows for shipment to Halifax. Each scow carries 24 skips. The skips full of blocks are unloaded by derrick on the wharf at Halifax and conveyed by motor truck to the site of the building operations. The scows, on their return trip, bring back cement, crushed granite and white sand as well as empty skips. The blocks, while on the skips, are carefully packed in excelsior, which prevents injury or staining.

A pier 1200 feet long extends out into the harbor and the trains of flat cars, loaded with skips, are run out on this pier, so that the skips are handled by means of a derrick or by a travelling crane directly from the cars to the scows. Co-ordination is arranged between the manufacturing and consuming ends, so that the shipment of blocks from the plant will not fall behind or exceed, to any great degree, the consumption at the building site.

In constructing the dwellings, the foundation walls are of concrete poured in wooden forms, all which are standardized and used many times. Contractors have worked out many ingenious devices for erecting and removing forms with as little labor and as little injury to the forms as possible. The concrete foundation walls are extended just above the concrete line. From this level to the level of the first floor, hollow walls are constructed of hydro stone, comprising an inner and outer wall with a space between. The "T" shaped blocks make it possible to use this double construction with horizontal and vertical air spaces. Above the first floor level the exterior walls are built of a single thickness of blocks, having two lugs instead of the one lug of the "T" shaped block. These project into the building and form studs to which wood furring strips are fastened and bishopric board and plaster applied directly. The back of the blocks is thoroughly covered with waterproof paint to prevent the passage of moisture through the joints.

Rapid progress was assured by the large size of the blocks. This made it possible to lay them up quickly with a small labor force.

The city engineer of Swift Current, Sask., Mr. J. W. Calder, informs the Contract Record that the proposed 25-ton team bridge is still in abeyance and that it is not certain whether the work will be gone ahead with this year. The 15,000 yards of pavement which it was reported would be laid this year, will not be proceeded with during 1919.

The labor troubles in Toronto are said to be responsible for the withholding of many large building enterprises until next year. It is stated that the activities of this season will be greatly curtailed, as many concerns had definitely decided to postpone their proposed construction work for this year.

Accident Prevention in the Contracting and Building Industries

Efficiency in the Construction Business Must Deal With The Human Element—Measures That Reduce Accidents, Therefore, Increase Efficiency

By Wills Maclachlan*

IF an investigation is made into the accidents occurring in the contracting and building industry in Ontario, it will be an eye-opener for anyone engaged in that business. During 1916, according to the reports of the Workmen's Compensation Board there were 31,581 days lost time due to accidents which caused more than 7 days lost time in this industry, or taking 250 days as the average working year, the industry supported 125 men under medical care, from which men they did not receive any constructive work. These accidents resulted in 729 temporary injuries, 61 permanent injuries and 15 fatalities. Surely at a time when every man was needed, every endeavor should have been made to cut down this absolute waste of human energy. More recent figures are not yet available, but it is safe to say that the record for 1917 or 1918 would not have been very much different from the one cited.

In making a start to prevent accidents, the first essential is for the heads of the contracting firms, or as the saying goes, the "big bosses", to really feel that accidents must be cut down to a minimum, and lend their real constructive support to methods of carrying this out. Without the hearty support of the head of any business, accident prevention usually becomes worse than useless, those in lower grades of authority paying little or no attention to the suggestions for the successful carrying out of the work. If the head of a firm will follow one of his accident cases to the home, and realize what it means there, his support will usually be enlisted. It is not a difficult matter to imagine the physical suffering of the injured man, but it is hardly possible to get a real idea of the worry and suffering of the man's family. In these times when a dollar has to be stretched as it has never had to be stretched, financial burdens due to sickness or accident, which are really not all covered under the Workmen's Compensation Act, should be cut to a minimum.

Human Element Sometimes Overlooked

In the building and contracting industry, we find a situation in which most employers were, not many years ago, employees themselves and they have, perhaps more than in other industries, the ability to see life through the eyes of their employees. Many of those, however, who are in the position of foreman and superintendent, are so engrossed in the work of mechanical efficiency that they sometimes forget the human element. There is also the difficulty in any construction work that tools and machinery, scaffolds or staging are for temporary use. The argument is often put forward that the conditions existing around the job are only temporary and will be done away with and superseded by a permanent structure within a very few days. The trouble with the situation is that it takes but a few seconds to injure or kill a man and it is found that most of the serious accidents are caused by

these temporary structures, the details of which are changing from time to time and the workmen have not time to become familiar with the hazards existing about them.

Personnel is Changing

In carrying on accident prevention work in a manufacturing plant, you are to a very great extent dealing with a working personnel that in normal times is not changing to a very great extent. This is not true in construction work and the labor turnover in this class of work is notoriously high. Whether it would be so high if working conditions were made a little better, is a question for the future to decide. Although the workers change quite frequently, the superintendents and foremen do not change in the same way. It therefore comes about that the keystone in any accident prevention work about a construction job is the superintendent and his foreman. At the present time, these men are held accountable for accidents which happen under their jurisdiction and it is certainly quite possible and probable that in the near future they will be held responsible for the accidents.

Most of the lost time on construction work can be classified under the following twelve headings:

1. Handling materials.
2. Handling tools.
3. Bad or broken tools.
4. Falling or flying objects.
5. Poor or broken stagings, scaffolds, and runways.
6. Lack of toeboards, rails and screens.
7. Falls or slipping.
8. Protruding nails.
9. Ladders.
10. Ropes, chains and cables.
11. Machinery and equipment.
12. Miscellaneous.

These causes of accidents are admirably summed up in a paper by L. D. Woedtko, Director of Safety, of the Fred T. Ley & Co., Inc., general contractors, of Springfield, Mass., which was read before the National Safety Council in St. Louis, an extract of which is as follows:

Handling Materials

1. Wheelbarrows, canthooks, ropes, chains and slings, blocks and falls scale boxes, dump and flat cars, derricks, cranes, etc., should be kept in good condition or discarded if unsafe. Constant inspection should be made and employees requested to report all unsafe conditions and to use danger tags for faulty or condemned equipment.

2. Stout, round runways, platform and stagings of selected materials and safe construction. Close supervision by foremen is required in this connection.

3. Proper piling and placing of piles of lumber, brick, pipe, cement, stone, tile, etc.

4. Continual cautioning by foremen against "fool-

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ing," the "dropsy habit," "butterfingers" and "overloads."

Handling Tools

1. Heads of bull points, chisels, drills and hammering tools dressed and trimmed every time points or edges are sharpened. Also care in over or under hardening.

2. All handles well wedged and supply of new handles on hand.

3. All tools stored in modern racks in tool houses, with heads, faces, etc., exposed to show condition and need of attention.

4. Danger tags in tin half-containers, conveniently placed in tool boxes, tool houses, field offices, etc.

5. Foremen, blacksmiths and tool men made responsible for inspection repair and upkeep of all tools.

6. Constant instruction and education against careless sawing, hammering, use of wrenches, etc., causing injuries to hands and limbs.

Bad or Broken Tools

1. Every accident from such causes should be closely investigated, bad tools to be especially called to the superintendent's and foreman's attention, and poor tools being called to the purchasing agent's attention.

2. There are many types of tools, references to which can be secured from the National Safety Council, and such data should be furnished the purchasing agent.

3. Tools showing inferior quality or defective material should be taken up with the manufacturer or dealer from which they were purchased.

Falling or Flying Objects

1. Suitable goggles should be provided on every job in every tool box and tool house. It is well to look over carefully the many types of goggles on the market and secure the advice and consultation of superintendent and foremen before buying in large quantities.

2. Superintendents and foremen must be held responsible for men wearing goggles when chipping and drilling concrete, stone, iron, steel, etc. Education preventives and sometimes force must be advanced to the rank and file on the matter of goggles by the foreman.

3. Extra sets of chipping and drilling tools should be provided on all jobs to allow other sets being repaired or sharpened and not delay or hold up any work.

4. Toeboards or skirt boards, screens, etc., on scaffolds, stagings and inclined runway where materials are stored temporarily, prevent men below being hit by falling objects.

5. Chutes for rubbish or waste disposal should be closed in all the way and well guarded on the ground.

Poor or Broken Stagings, Scaffolds and Runways

1. Sound material of adequate strength, well selected and constructed, without weak knots, also no loose boards.

2. Hand rails or ropes, also screens, in addition to toe and skirtboards on all exposed edges of staging, scaffolds, runways, floors and elevator shafts, openings, etc.

3. Diagrams made by our foreman directly in charge of work on which scaffolding, stagings, runways, etc., broke or caused accidents should be secured and the causes ascertained, so that all other jobs may be advised accordingly.

Lack of Toeboards, Rails and Screens

1. As this heading has so much in common with poor or broken stagings, scaffolds, and runways, see recommendations under that head.

2. Impress on superintendents, foremen and men, the injustice of causing injuries through lack of foresight and care in this regard.

Falls or Slipping

1. Passageways, floors, driveways and working spaces should always be kept clear of waste or surplus material.

2. Gates and railings at elevator and hoist shafts, floor openings, etc., should be located at least sixteen feet away from openings to prevent persons leaning, being struck, or slipping through the opening.

3. Fooling on stairways, ladders, scaffolds and stagings should be cause for serious reprimand and discharge, if necessary.

Protruding Nails

1. Waste and debris should be kept cleaned up properly and disposed of through rubbish chutes or piled out of the way.

2. Kegs and cases, when opened, should have protruding nails withdrawn or bent over.

3. Stripped forms in concrete work should be piled clear of passageways as taken down, and protruding nails piled downward until attention can be given them.

4. Every man on the job, from superintendent to water boy, should constantly turn over or pick up loose boards or planks with protruding nails. Water boys, tool men, etc., can be equipped with hammers on belts and constantly bend over or pull out protruding nails about the job.

5. Under no circumstances allow an injury from nails to go unattended and make the superintendent and foreman responsible for attendance by a doctor immediately, and advocate the doctor using anti-tetanus serum, if at all doubtful, as lockjaw cases are almost hopeless in advanced stages.

Ladders

1. Do not allow ladders to be painted with pigment or lead paint. Insist on new ladders being treated with linseed oil and shellac, so that defects or deterioration will always be visible.

2. Continually discouraging the use of homemade ladders and occasionally call for a report from every job as to the condition of all ladders.

3. Co-operate with the purchasing agent in securing the best possible materials in ladders, and even safety types for certain kinds of work where advisable.

4. If safety feet are used, be sure the type purchased is suitable for universal conditions, such as concrete, wet wooden floors, steel surfaces, etc., as well as for use on the ground. This is a difficult problem and the the superintendent and foreman should be carefully consulted on same.

5. Ladders should be well braced or lashed to prevent slipping, wherever advisable; the safe angles of placing ladders should be compiled with. The National Safety Council recently issued a bulletin showing safe angles for ladders of various lengths.

Ropes, Chains and Cables

1. Up-to-date tables of safe loads at various angles of slings for ropes, chains and cables, should be furnished all superintendents and foremen and posted on bulletin boards. The tables shown in old style engin-

earing handbooks are now pronounced inadequate by safety engineers, on account of present day material used in their manufacture.

2. Coils of ropes should never be stored near acid carboys, the fumes of which disintegrate the fibre without same being visible.

3. Purchasing agents should be furnished with up-to-date specifications on which to buy hand-made or machine-made chains. The National Safety Council will furnish these specifications on request.

4. Caution superintendents, foremen and men "to stand from under the load," "avoid kinks, twists and sudden jerks," "keep loads off points of hooks," "keep cables well lubricated" and store them away from alkalis, gases, fumes and acids.

Machinery and Equipment

1. Daily inspection by foreman, rigger or some responsible person of all hoisting apparatus and mechanical equipment on the job and a thorough overhauling at main equipment plant on return from a job.

2. If equipment is sent from one job to another, thorough overhauling or repairing should be made, or if same is not practical, all defects or attention needed should be marked with tags and a memorandum or letter forwarded to the job where such equipment is being sent.

3. All gearing, keys, setscrews, exposed shafting ends, revolving projections, etc., should be thoroughly enclosed or well guarded on hoisting engines, drums, winches, mixer, screens, steam shovels, saws, mechanical clutches, grinding wheels, etc.

4. Safety collars and couplings, headless set screws, shaft pulleys and clutch housings, etc. wherever practicable; adequate grab handles and steps on large equipment, such as locomotives, steam shovels, cabs, cranes, dump and flat cars, etc.

5. Correct guards on gauge glasses and water columns. This is a serious problem, as many types of gauge glass guards are not practicable, because they require additional holes in boilers, some of which already have too many holes, and cause considerable expense, and also loss of time while same are being installed. Types of gauge glass guards are now on the market which can be slipped on instantly, and do not require any drilling of boilers, loss of time or disuse of equipment; master mechanics, engineers, etc. take more kindly to these types.

6. Cylindrical or safety heads provided on jointers or buzzplanes, approved safeguards such as spreaders, etc., on all saws (circular, spread, crosscut, overhead, treadle, swing, band, etc.)

7. Hooks for large hoists, cranes, derricks, etc., provided with handles on the back, and, where advisable, with guards over points of hooks. It is well to consult with the master mechanic and especially the rigger blade enclosures, travel limits, table guards, pushers, and hoisting man on this matter.

8. Pulley blocks, whether wood or iron, should be equipped with adequate side plates or flanges to protect mesh points between ropes and blocks. Bearings, pins and wheels, should be carefully inspected periodically, as this equipment gets much abuse and wear.

9. Advocate thorough inspection of all mechanical equipment on rainy days, when it is likely some superintendent, foreman, mechanic or rigger may be idle.

10. Such equipment might just as well be purchased with the safety idea, such as safety types of gas-line cans, carboy inclinators, hammering tools, drills,

bull points and chisels of the best steel, well tempered, etc.

Miscellaneous

1. Adequate shoring and excavating, or tops kept broken down to prevent caving.

2. Appropriate danger signs, tags and warnings. On account of men working above or below dangerous passes, forbidding riding on elevators, the public warned to keep out, fire prevention notices, occasional patriotic bulletins—assisting the government in Americanization, Liberty loans, thrift stamps, campaigns against venereal diseases, etc.

3. First class guards, protecting exposed electric switches, wires, transformers, etc., against personal contact by use of cabinets, enclosures, warning signs, etc.

4. Children and the public being kept away from construction work where they have no business.

5. Fire prevention methods, boilers safely housed, spark guards on smokestacks, spark screens on salamanders, fire extinguishers in job offices, tool houses and appropriate parts of the work. (The National Fire Underwriters' Association will furnish you bulletins on fire prevention.)

6. A surprising number of men are disabled and lose time through causes other than accidents. Sunburn, poison ivy, bad drinking water causing dysentery, infection from boils, pimples, etc. Personal advice and caution by superintendents and foreman can reduce this cause of loss of time in many instances.

An increasing number of eye injuries is found on any construction work. This is especially true, among steel workers or workers cutting concrete or stone. Any contractor will do well to require such workmen to wear goggles which will reduce the eye accidents to a minimum.

A matter that might well receive the very serious consideration of contractor's associations is that of having scaffolds put up in a permanent way and owned jointly by the various contractors carrying out any work. Such scaffolds can be put in a more substantial way and will certainly be far safer. This matter needs only a limited amount of co-operation to put into successful working.

Stepping from the question of co-operation between various contractors, it is very natural to come to the point of co-operation between contractor and his employees in the prevention of accidents. Any contractor who will have formed among his employees a committee for the prevention of accidents and who will take time to sit down and discuss matters with such a committee, will go a long way towards reducing his accidents to a minimum. Such a committee should not be what is commonly called a grievance committee, but the men should be advised that it is constructive suggestions and criticisms that are required and if both enter into the work with the common object of preventing accidents and making for a saving for both contractor and employee, beneficial results are sure to be obtained.

Efficiency in the contracting business as well as in industry in general has too much been weighed from purely material and very temporary standards. In the future, efficiency will far more deal with the human element and more permanent forms of progress than it has done in the past. In obtaining this better type of efficiency we will arrive at a real efficiency that we have not been able to obtain in the past, although we have been striving for it.

Present Abnormal Conditions Can be Offset by a Study of Economy in Building Design

Adaptation of a Building to Its Purpose, Determination of Type of Construction, Convenience of Erection are Points to Observe to Save Money

By A. H. Harkness*

NOTWITHSTANDING the great lack of accommodation in practically all lines of industry, and for the housing of the people of the country, the building industry has not yet become any way near normal in volume or value. The two most apparent causes for this condition are the unsettled state of labor and the greatly increased cost of building as compared to the period previous to the war. This increased cost may be considered to average as much as seventy-five per cent. Many building schemes which are projected with pre-war costs in mind, are immediately dropped when the promoter ascertains what his contemplated building is likely to cost. In some cases, plans have been prepared and tenders received before the project is laid aside, in other cases an honest estimate of the cost is quite sufficient to cause the owner to postpone operation in the hope of getting better prices in the future.

Whether there is any possibility of the cost of building ever approaching the old level or not is open to question. The probability is that there will be no substantial reduction. It is inevitable that the cost of building must vary directly as the cost of labor, and it is very improbable that once having obtained a certain scale of wages, the labor unions will ever be prepared to accept less. Any one requiring additional accommodation would perhaps be well advised to accept conditions as they are. A certain amount may be accomplished to help the situation by a very careful study of economy in both the design and construction of a building.

Building Adapted to its Purpose

The first and most important consideration in the planning of a building is that it be adapted to its purpose. This will very often exceed in importance any question of economy that might be affected by difference in the type of design. The improper planning of a factory may easily result in an annual waste, quite equal to the annual carrying charge of the structure. But after the building has been planned to best suit its purpose, there may still be a very wide difference in its cost depending upon the materials of which it is constructed and then again in whether the best use has been made of those materials.

In designing a building, it is seldom that the question arises as to whether it is to be a permanent structure or not. However this question does occasionally arise, and often produces rather perplexing problems. If it is required to heat the building, the cost of protection against the weather by a certain amount of insulation has to be compared with the cost of heating for the assumed life of the building. The scrap value of the building at the end of its period of usefulness is worthy of being taken into consideration.

In permanent buildings, where the type is not at once determined by the character of the plan, there may be a choice of four or five different types of construction, any one of which will serve the purpose

perhaps as well as any other. For instance, a warehouse might be built with the ordinary joist construction or of slow burning construction, of reinforced concrete, of various combinations of wood and steel, or of steel frame fireproofed with tile, or with concrete. Any one of these types might house the materials to be stored as well and as conveniently as any other. The question as to which type should be adopted requires the use of the best judgment of the designer.

Determination of Type of Construction

Perhaps the most important consideration in determining what type of construction should be used is the fire hazard, both internal and external, and its effect on the rate of insurance. Knowing the cost of two different types of construction and the difference in the insurance rate it is only a question of arithmetic to determine which is the more economical. The designer should bear in mind however, that perhaps not fifty per cent. of the loss due to a fire can be covered by insurance. It is only the loss on the building and contents that can be protected. Any loss, due to the interruption of business, has to be borne by the owner. The effect of the use of any material on the insurance rate should be ascertained and given careful consideration. It is very good economy to expend more in first cost on account of getting a better insurance rate by so doing.

If a fireproof building is the more desirable, it will generally be found that reinforced concrete will be cheaper than steel frame fireproofed, though for other reasons in some cases, the steel frame may be the more desirable type of construction. If reinforced concrete is used a careful study should be made of the column spacing, of whether to use the flat slab or the beam and girder type of construction, of whether to make it skeleton construction or wall-bearing. Generally speaking the closer the column spacing the cheaper the construction will be, within certain limits, so that in this respect the cost has to be considered in its relation to the convenience of the plan. For buildings up to a certain height it will prove more economical to carry the floors on the walls, while above this height it is more economical to carry the walls on the concrete framing. Each case is a problem in itself and must be determined by an examination of the relative costs of the different methods, not forgetting to take into account the relative convenience of the two in the matter of construction. In the beam and girder type careful consideration should be given to the spacing of the beams, and its effect on the thickness of slab and cost of form work. A careful examination of the design of all beams and columns should be made to be sure that the most economical proportions between the concrete, steel and forms have been obtained. Different floors should be designed as similarly as possible so that the forms may be re-used with a minimum amount of alteration.

A careful investigation should be made as to the

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relative costs of the different foundations which, in many cases, may be used. It is not unusual that there are three or four possible different designs for a footing and the cheapest design may not, by any means, be apparent without actually designing and estimating the cost of each.

Convenience of Putting a Building Together

The convenience of putting a building together from the contractor's standpoint should always receive consideration. It is more particularly in the matter of details that a designer can do a great deal to make the work more economical and convenient for the contractor. The way steel sash are set into the concrete, the avoidance of spandrel beams projecting above the floor level, unnecessary variations in the sizes of beams and columns, are cases in point.

It would be possible to enumerate an almost indefinite number of particular items to be considered from the standpoint of economy. In fact, should a person attempt to point them all out he would require to make a complete list of all the items that go into the construction of a building. The designer should bear in mind, that, whatever he does, there may be a cheaper way, equally good, of doing the same thing, and he should make every effort to think of that cheaper way.

After the last four or five lean years in the building industry, architects, engineers, contractors, and supply men are all anxiously hoping for an amount of business that will, to some extent, compensate them for their long wait. Each can do his part towards bringing this condition about by hard work, care and modest ambitions in the matter of profits until the industrial conditions of the country become more normal.

Economy is Feature of Steel Construction When Properly Designed

In These Days of High Prices, Steel is Claimed to Have Desirable Advantages That Make it an "Efficiency" Material

By J. W. Smith*

A FEW years ago building materials in general and steel in particular were so cheap that there was not as much incentive for strict economy as exists to-day when costs are high. As yet the world has not become thoroughly reconciled to the high price level and there is considerable hope that prices will at some time in the future return to something approximately the former level. In face of the high cost of living and labors' demands, it is difficult to see how this is going to be brought about. No one is willing to accept a lower wage or a price below cost principally because it is impossible for him to do so and exist, and if prices are reduced at all it will be a matter of years before such action occurs. Builders are therefore anxious at present to construct at the very lowest cost possible, and this calls for considerable efficiency in design.

During the last few years steel has been in such demand for war purposes and prices have been so high that substitutes have been used wherever possible. Many structures have been built of reinforced concrete or wood that would have ordinarily been built of steel, and many builders have not yet become entirely acquainted with the fact that steel is obtainable again for all purposes and at reasonable prices, in fact, at low prices considering the cost of production and as the steel mills and steel fabricating shops are not filled with orders, rapid deliveries can be made.

Desirable Features of Steel Construction

There are many reasons why steel construction is desirable. One of the most important is speed. A steel design can be prepared in the minimum of time and the entire work executed often in less time than it would take to prepare the design alone in reinforced concrete. Another important consideration is safety. The making of structural steel is an exact science and there exists no doubt as to its strength. There is no uncertainty such as exists with concrete made at the site by unskilled labor, which, by the way, requires a

great deal of supervision. Mistakes are liable to occur, such as the placing of the reinforcing at the top instead of the bottom of a beam or slab which usually results in failure and often in loss of life. Steel constructing requires no particular supervision other than that provided by the steel fabricator.

Economy is the advantage that appeals most strong to the purchaser. Steel can easily hold its own against other building materials at present prices. Used in conjunction with certain other light building materials a very economical structure can be produced.

Materials in Conjunction With Steel

Gypsum slabs for roofs, for example, have several advantages over a concrete slab. They weigh only 60 lbs. per cu. ft. against about 145 lbs. for concrete. They are obtainable 15 in. wide by 4 in. thick and in any length up to seven feet, the weight per square foot being only 20 pounds; a 4-in. concrete slab weighs 36 lbs. No timber form work is required which, at present prices of timber, is a big item, no reinforcing is required, and they are placed with a minimum amount of labor. They also have the advantages of being fireproof and non-conductors of heat, cold or sound.

Wood is a very light building material and can be used often to very good advantage in connection with steel, especially where a fireproof building is not considered necessary.

For buildings such as forge shops or steel plants where perfect dryness or warmth is not required a building covered with corrugated iron will be found to be economical. Galvanized corrugated iron weighs only 1 to 3 pounds per square foot and, therefore, the steel frame can be made comparatively light.

Cement tile is an ideal roofing material for certain types of buildings. Interlocking tile requiring no other roofing material and laid directly on the steel purlins is ideal for a roof with a pitch of about 6 in. in 12 in. or steeper. Standard sizes are 26 in. wide, 1 in.

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thick and 52 in. long, weighing only 14½ pounds per square foot of finished roof.

Flat tile for use on roofs with a small pitch are obtainable 24 in. wide 1½ in. thick and 60 in. long and weigh 17 lbs. per square foot. A composition roof is usually placed on the flat tile to make it waterproof.

A comparison of weight of walls is interesting.

	Weight per cu. ft.
Brick wall (13½ ins.)	140 pounds
Tile wall (12 ins.)	40 "
Brick wall (9 ins.)	95 "
Tile wall (9 ins.)	33 "
Wall of 9 in. tile faced with brick	80 "

Reducing the weight of walls saves in the weight of steel lintels and also reduces the size of foundations. Use of hollow tile provides a very desirable air space in the wall, and a good plastering surface.

Each problem requires careful thought and individual treatment. To secure the best results owners, architects, consulting engineers and building contract-



Fig. 1.—One day's progress on a steel building on which quick erection was demanded

ors should consult freely with reliable steel fabricators who are more than willing to offer suggestions, and make recommendations without charge. Being in close touch with the material market and handling, as they do, many structures of various types they are in the best position to advise.

Simplicity Means Cheapness

Simplicity is an important consideration also. The lightest structure is not necessarily the cheapest. The additional weight of a heavier construction is often more than offset by the increased labor cost of the lighter structure. In general, the simplest design is the cheapest. Design drawings should contain all information required by fabricators so that it will be unnecessary to waste time seeking information. The clear cut job always secures the best price. When necessary to show steel details on the design drawings and attempt should be made to keep these as simple as possible but details should be left as far as possible to the fabricators so that they will be free to use standard construction where possible.

Something can be said for the contract which permits the contractor to economize on the design with a division of the saving between owner and contract-

or. This scheme has usually been to the advantage of both parties. Often a steel design can be altered in such a way as to not only reduce the cost of steel but to also economize on other materials.

This is the dawn of an age of co-operation. Let the owner, architect, engineer, and contractor get together and consult freely and the result will be economy and efficiency.

Efficiency in Steel Erection

ONE of the principal advantages in using steel frames for buildings is the rapidity with which they can be erected thus permitting the other trades to follow quickly, the ultimate result being the completion of the structure in the minimum amount of time. During the war, steel was used wherever possible principally for this reason, many buildings with steel frames being erected for the manufacture of munitions and other war materials.

Examples of Speedy Erection

One of the buildings erected in Canada notable for rapid construction was a machine shop for Motor Trucks, Limited, at Brantford, Ontario. P. H. Secord & Sons were the general contractors. This building was of a standard type, three 30-ft. bays in cross section with a length of 700 ft. divided into 35 panels of 20 feet each. It contained 220 tons of steel. This building was erected for the manufacture of shells for the United States Government and speed was essential.

The erectors arrived at the site Monday afternoon, June 3rd, 1918, and the entire steelwork was erected and riveted on June 12th, in a period of 8½ working days, with a force of 17 men.

Figure 1 shows the general outline and one day's erection. Note how the bricklayers are following up the steelwork. Figure 2 shows all steel erected, with the roof, walls and steel sash being placed.

The erection equipment consisted of a derrick car which unloaded and distributed steel and erected the bay beside railway track; also two wooden gin-poles operated by one double drum hoisting engine, which erected the other two bays.

Another fine example of steel erection is shown in a heat treatment building of standard forge shop type



Fig. 2.—Complete steel frame of building shown in Fig. 1. was erected and rivetted in 8½ days

for the same plant as the above. This building is 80 ft. x 198 ft. in plan, and contained 94 tons of steel. Erection was started on July 26th. Figure 3 shows the frame practically complete on August 2nd, and on August 10th the rivetting was completed. The entire work was performed in 14 working days by a force of

8 men. The erection equipment consisted of one wooden gin-pole operated by a hoisting engine.

The Skyscraper Type

Figure 4 illustrates a type of building not so common but a necessity in large cities where land values in the business sections are very high.

This illustration shows the Royal Bank Building,

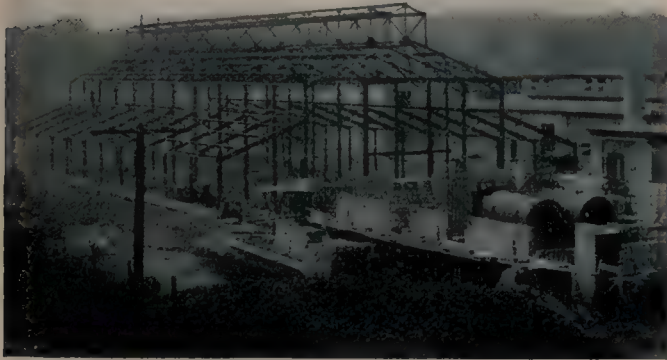


Fig. 3—Steel framing of this building was completed in 14 working days with a force of eight men

Toronto, in the course of erection. Steel frame is, of course, the only construction suitable for this type of structure. Hollow tile flat floor arches are nearly always used, being placed floor by floor after the steel work is riveted. The walls are carried on the steel at

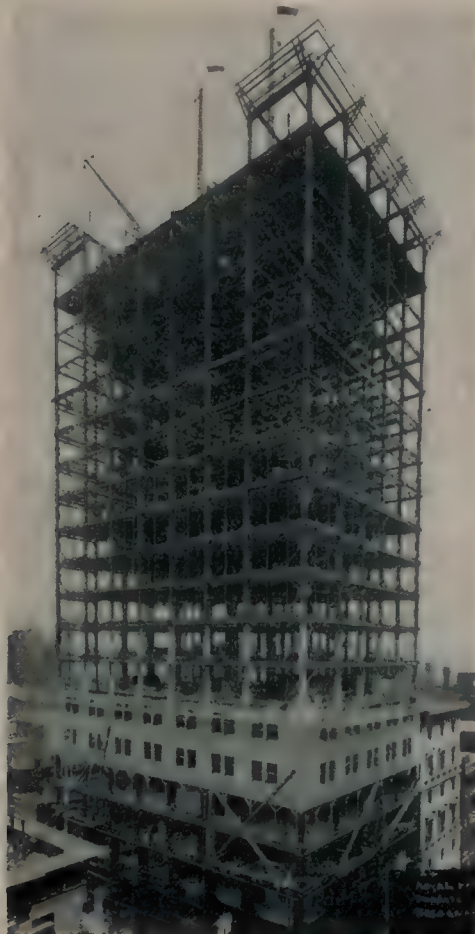


Fig. 4—The Royal Bank Building, Toronto, in course of erection

each floor, and work can be started at almost any level. The illustration shows the walls starting at the 5th floor; the masons working from a scaffold hung from cantilever beams at the 13th floor. More than three stories of walls were placed in one week on this structure. The wooden derricks at the 3rd floor level are placing the stone work of the lower stories.

The steel frame was erected by two steel gayed derricks. These are shown erecting the upper stories. Steel was delivered by teams on Yonge and King streets. The derrick booms which were of sufficient length to reach out over the teams and pick up the load, raised and deposited the steel on the last floor erected. Columns were in two storey lengths. Derricks erected two floors of steel from each level, and were raised two stories at each move.

Street Traffic Limited Progress

The gayed derrick is the best equipment for this job because of the ease and speed with which it can be raised, four hours being a fair average of the time required for the entire operation. There is about 3,000 tons of steel in this structure and it was erected in about three months, an average of 40 tons or 10 team loads of 4 tons each per day. The erection was pretty

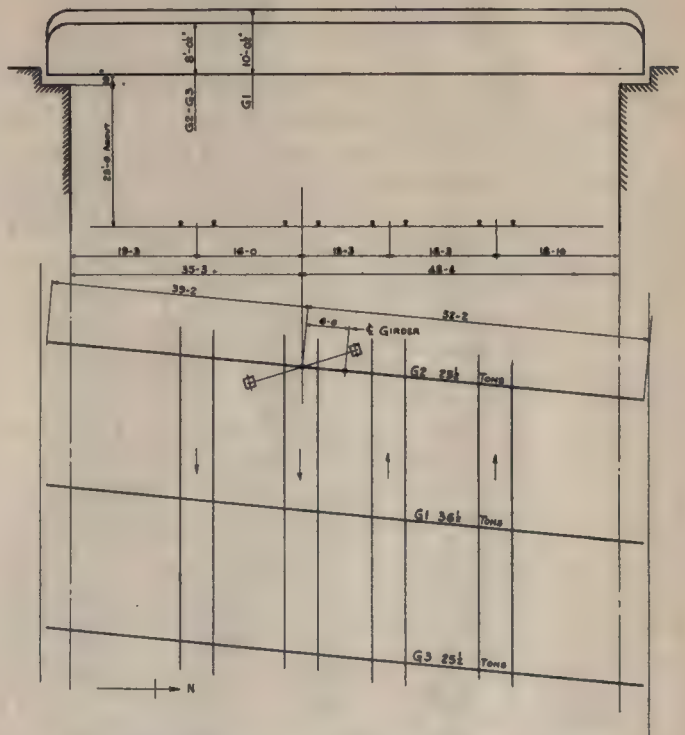


Fig. 5—Girders of Strachan Ave. bridge in plan and elevation

well limited by the number of teams that could be loaded and delivered to the site and unloaded early in the day before street traffic became heavy. The illustration shows, however, that the steel frame was well in advance of the other trades permitting them to proceed without delay. These results were obtained by careful planning in advance and co-operation between the steel and general contractors.

This article would hardly be complete without reference to bridge erection. The Strachan Avenue bridge, Toronto, over the Grand Trunk Railway affords a very good example of rapid and efficient erection. This bridge is of a through plate girder type. The girders are 91 ft. 4 in. long, the two outer girders



Fig. 6—Gallows frame and locomotive crane lifting plate girders

being 8 ft. deep and weighing $25\frac{1}{2}$ tons each; the centre girder is 10 ft. deep and weighs $36\frac{1}{2}$ tons.

Placing Long Bridge Girder Spans

Figure 5 shows the girders in plan and elevation with relation to the railway tracks. It was necessary to maintain traffic and in order that the erection and traffic might be interfered with as little as possible the work was performed on Sunday, when railway traffic was comparatively light. The erection consisted of a gallows frame about 50 ft. high, the legs being 14 x 14 timbers braced, and capped by two 18-in. beams at 55 lbs. There was sufficient clearance between the legs of the frame to permit trains to pass, when astride the track.

The girders were delivered on flat cars in a vertical position the two lighter girders being loaded together. They were placed on the track south of centre line and shunted to position under the gallows frame. Since the centre of the frame was not central between abutments the load was unbalanced. This was overcome on the first girder placed by hanging a box of steel punchings weighing about five tons on the short end of the girder and on the other two girders a locomotive crane took hold of the long end and balanced it until placed on abutments.

The hoisting tackle consisted of 18 parts of $\frac{5}{8}$ in. diameter cable, the ends passed through a snatch block at the foot of each leg of the gallows frame and attached to a locomotive, a few minutes only being consumed in the actual hoisting operation. After the first girder was in position, one leg and cap of the frame were disconnected and lifted over the girder and placed in position for the next lift by a light stiff leg derrick placed on the south bank, the other leg of the frame being skidded to position and then bolted together ready for the next lift.

Figure 6 shows the first girder in place and centre girder being raised.

All of these structures were fabricated and erected by the Dominion Bridge Company, Ltd., Toronto. Mr. T. B. Wells being in charge of erection.

Higher Efficiency Must Come Through Higher Individual Efficiency, Rather Than Through Mechanical Efficiency

By Dudley R. Kennedy*

MANY struggling developments have come out of the war, so diverse and ramified as to make it impossible to dwell even briefly upon even a fraction of them, but one fact is receiving universal discussion, to wit, the high cost of living and the ever increasing demand for more wages by reason of the cost of living.

Both in Canada and the United States the public school system and general educational facilities have almost religiously held aloof from the discussion of such matters as capital, its investment, proper return thereon in the shape of dividends, the difficulty of financing large plants and holdings, the involved principle of credits, and many other points involved, so that the rank and file of our people are in almost total ignorance of those things which the average business man considers fundamentals of business. There is just now beginning to crystalize in the minds of the more intelligent leaders a new type of public opinion which seems to sense the fact that the ultimate consumer, since he pays the bill—whether it be for wages or dividends to stockholders—has a real interest in the relations of employer and employee.

Wrong Conception of Wage Earning

The grand collection of ultimate consumers, which means society as a whole, have been carrying the burden of increased cost and increased wages and, while it seems almost too fundamental to need repetition, it seems that somewhere in the hurly-burly of our war time thinking we have all lost sight of the action that wealth must be created and that a man must **earn** everything that he gets. For some years past we have been confusing **pay** or **wages** with **earnings**, as applied to working people. They are, as a matter of fact, quite different things.

If it were only possible to make every man, woman and child understand that by delivering thirty, forty or fifty per cent. efficiency for one hundred per cent. pay they are not cheating or putting anything over on their employer, but are in reality cheating themselves. In the last analysis, the employer, not being a philanthropist, simply adds the additional cost of manufacturing his goods to his selling price and passes the whole along to you, to me, to the very individuals in fact who help manufacture the product, and so on and so on, while the price of stable articles increases and the wage earner, through this mistaken theory of basing wages upon the cost of living, endeavors to catch up with his ever mounting bills.

Higher efficiency must come through higher individual efficiency, rather than through mechanical efficiency, because it is hardly possible that there is enough slack between present mechanical efficiency and a hundred per cent. mechanical efficiency to take care of the present situation. It is rather to be hoped and devoutly prayed for that through such mediums as your magazine and our thinking press as a whole that the economic action can be gradually but surely conveyed to every person who works, to the end that full appreciation may be had of his or her obligations, not only to the individual, but to society, which is only a collection of individuals.

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Organization as a Means to Higher Efficiency in the Contracting Business

United Action is Wanted in Dealing with Problems of Industry in Order to Determine Progressive Policies and Eliminate Difficulties and Bad Practices

ORGANIZATION" and "Efficiency" are words that have become somewhat stale in the last few years. They have lost their one-time charm. They have, as a matter of fact, been overworked, but—the ideas they represent have not yet been put to effective use in many of our industries. The men of the building and construction industry are, we think it must be admitted, in no position to cast stones at their neighbors for this fault. They have discussed organization, of course, and have organized in many localities, but have not yet reached the point where their industry might be termed a well-organized one. There is still much to be desired and there is, perhaps, a danger that enthusiastic workers who, through lack of the necessary co-operation from the trade in general, have not yet seen adequate results for the time and energy they have given to association activities, may become disheartened before the real fruits of their labors can be reaped. It seems opportune, therefore, to again take up the question of organization, and in the paragraphs which follow, it is our object to point out, briefly, its possibilities as a means of increasing efficiency in the contracting business.

United Action in Dealing with Problems of Industry

The main purpose and underlying idea of organization is to obtain united action in dealing with the problems of industry. What the problems of the building industry are, the men connected with it know very well. First and foremost, perhaps, is the difficulty of cut-throat competition. There are men in the contracting business who are spoiling the game for those who are anxious to do a fair job for fair remuneration. This type of contractor often makes money, but it is either through skimping the job, at the expense of the owner, or in the bankruptcy courts, at the expense of his creditors. One thing he certainly has succeeded in doing, and that is in lowering the status of the contracting business. Square dealing must be forced on this man or he must be forced out of the business, and the only effective way of doing this is to bring pressure to bear upon him through a strong organization, either by educating him or by establishing such relations with the supply men and the labor unions as enables it to control the situation. In this respect, strong, representative trades' unions are a distinct advantage to the legitimate contractors, when they themselves have an active organization, as they can, through the co-operation of the labor party, get a strangle hold upon the man who refuses to play the game honestly and fairly.

Who Can Explain the Workings of the Lien Laws?

No doubt there are contractors in the various provinces who, through careful study, have come to an intelligent conception of the workings of their respective lien laws, but in many cases they are extremely puzzling and even Philadelphia lawyers find it difficult to correctly interpret them. The Ontario Act, for

instance, has been amended and rehashed on so many occasions that the original form is not now recognizable in it, and in the average contractor's mind there is considerable doubt as to the results of its application. This is hardly a desirable condition, and surely here is another opportunity for useful service for both local and provincial organizations. The Ontario Legislature, at its last session, when the matter of the Lien Law was brought up, decided to leave it over till the next session, and in the meantime a commission is being appointed to frame a new Act which will be more adequate to meet the requirements. It is to be hoped that through the medium of the local Builders' Exchanges and the Provincial Association, recommendations will be made which will lead to the enactment of equitable and comprehensive legislation. In the meantime the matter should certainly be thoroughly thrashed out, and it is only through publicity that it can be done properly.

Price Peddling

One of the most vicious practices in the building industry today is the peddling of prices. The general contractors accuse the architects and owners in this respect, and the sub-contractors accuse the general contractors. Speaking to a prominent sub-contractor recently, he stated that in his city—a big one—there were only three general contractors with whom he had had dealings who had not called him in after they had received the contract to ask him to cut his price. As a result he had a feeling of animosity towards the general contractors, and indeed, wished they were out of the field altogether—owners and prospective builders, however, probably do not agree. Now this feeling of distrust and antagonism which, it cannot be denied, exists to some extent between sub-contractors and general contractors, works to the detriment of the industry, and the only way we know of rectifying it is through the various sections getting together in the exchanges, discussing their problems, setting a high code of ethics so as to introduce a keener "conscience" in the trade, and bringing about a better understanding, through fellowship. It may be pointed out here that the Open Price Plan is one very effective means to protect a man from being beaten down in his price under false pretences, and we think it is well worth while for the local exchanges to consider the introduction of this plan.

Difficulties in Contract and Specifications

Every contractor knows that the average architect seeks to draw up the specifications in such a way as to protect himself and cover his mistakes at the expense of the man who signs the contract. Blanket clauses are introduced which would be almost ridiculous did they not sometimes prove rather serious to the contractor. Now why should it not be possible for the contractors, through organization, to defend themselves more fully than they do? Why should a form of contract not be drawn up which would give ade-

quate protection to both the contractor and the owner, and which would be standard for the Dominion? It seems that the proper course would be for the local exchanges to discuss the question and make recommendations to the provincial associations, which should in turn thrash it out and pass their recommendations to the Dominion organization. In this way all would have an opportunity of expressing their opinions. Perhaps, as a basis of discussion, it would be the best procedure for the Dominion organization to make a draft specification in the first place.

Dealing with Labor

And perhaps the Labor Unions are the best reasons for Builders' Exchanges. Surely it must be evident to all the men of the industry that it is altogether impracticable to deal satisfactorily, as individuals, with the labor unions. To create a balanced condition in the industry, it is necessary the employers should be as united as the employees. If the labor organizations are extreme and unreasonable in their demands, it is essential that the employers should present a united front in opposition to them, and it is just as essential for the purpose of bringing about harmony and co-operation that both sides should have strong, representative organizations. In the towns and cities where builders' exchanges have not yet been organized, and where, perhaps, serious labor difficulties have not yet arisen, let the men of the trade take warning from the conditions of unrest and agitation which exist all over the Dominion to-day and get together before they become involved in the troubles which in other districts and other industries have virtually spoiled the season's business.

The Ideal Exchange is Exchange of Ideas

The greatest advantage of getting together in an association lies in the opportunity for the exchange of ideas. It is said that ideas are worth dollars. The estimate is wrong. Genuine ideas are worth more than dollars. Indeed, their value cannot be calculated in dollars and cents. But they are worthless and non-productive until they are expressed. A man may have his mind full of good ideas, but if he does not express them in words or in actions, they are of as much present value as the undiscovered mineral deposits which may be hidden in the Peace River Country or the Ungava. And a man's ideas are not rightfully his own exclusive property; they should be used for the betterment of his industry, his community and his country. Every citizen should contribute to the flow of mental energy which drives the machinery of state. Every employer and every employee in industry should contribute, in proportion to his talents, to the mental storage battery which forms the reserve of power for the rectification of the ills of his particular industry. The Builders' Exchanges, linked together, by a proper form of organization, throughout the provinces and throughout the Dominion, should form the storage battery or power reserve for the rectification of the ills of the construction industry. The "mental voltage" depends upon the contribution made by the individual. How high is the "mental voltage" in the building industry?

The greatest practical advantages should be brought about through exchange of ideas on the improvement of methods in construction work, in organization, in cost-keeping, and so on. Let no contractor deceive himself by imagining that he has a monopoly of the best methods, and that by pooling his ideas in

his association he is going to give more than he gets. We are reminded of a clever little saying we saw recently: "You have a dollar and I have a dollar. We swap. I have your dollar and you have mine. We're no better off. You have an idea and I have an idea. We swap. You have two ideas and I have two ideas. That's some difference." And the law of life that there can be no increase without union holds good in the realm of ideas. You never got a new idea in your head that did not result from the union of two ideas you already had. The boat is an idea and the engine is an idea; they united in somebody's brain and we got the steamship. Steel construction is an idea and concrete is an idea; somebody brought them together and we got reinforced concrete. So when you get an idea from the other fellow it may become wedded to some of your own and produce a new one.

Progressive Policies in the Industry

If progressive policies are to be pursued in the building industry, generally, they must be taken up and promoted by the exchanges. And progress we must have. The evolution of half a century has been compressed in the revolution of five years. Can any one industry, therefore, afford to travel along the same old course along which it was travelling in 1914? Surely not. We of the building industry must strive with all our energies to adjust ourselves to the new and unprecedented conditions. We must try out every idea which seems as if it may make for efficiency. We must adopt every plan that is in keeping with the spirit of the new age. In this issue, some ideas are suggested which look as if they may be considered in the progressive class—for instance, the Open Price Plan, the quantity surveying system, the cost plus contract. Whether or not these are thoroughly practicable and valuable is open to discussion, but right there is the point—they ought to be discussed. It is the duty of the builders' organizations to take them and thrash them out, and determine whether it is worth while to apply them. It is as great a crime in these days to waste ideas as it is to waste our natural resources or the physical well-being of the nation.

Finally, organization is necessary to bring about harmony and co-operation in the industry. The day for narrow-minded rivalries and petty jealousies is past. No longer is it good business to try and drive your competitor into the bankruptcy courts. It does not pay, for the simple reason he'll try and do the same to you, and both may come to the wall. And apart from this selfish standpoint, shouldn't we be broader-minded as individuals and bigger and more wholesome as an industry than we were before the war taught us the lesson of co-operation? Can't we get together—all of us—get our rough corners smoothed off, try and appreciate the other fellow's viewpoint, or better still, establish one viewpoint, one central aim and object, for all the men of the trade—the building up of an industry worthy to be the pioneer in development of Canada as a British nation.

\$200,000 Warehouse in Hamilton

Bernard H. Prack of Toronto has been appointed architect and engineer for the new warehouses for Wood, Alexander and James, Hamilton. Plans and specifications are being prepared and it is expected that tenders will be called in about two weeks. The estimated cost of building is around \$200,000.

Efficient Protection of Iron and Steel Structures Obtained by Properly Selected Paints

True Causes of Corrosion Must be Appreciated—Functions of Various Coats and Factors Governing their Efficient Application

By John Grieve*

EFFICIENT protection of iron and steel structures can be obtained only when the true causes of corrosion are appreciated and effective means taken both in the design and maintenance of a structure to combat these causes. At the present time no indestructible or permanent protection is known, but by the use of properly selected paints in conjunction with efficient design, maintenance work may be reduced to a minimum and costs kept to a figure which represents a premium of a fraction of one per cent. per annum, while the structure will be maintained without appreciable deterioration.

The deterioration of steel structures is caused by electro-chemical action between the steel and the surrounding elements or, what is often overlooked, by similar action between various members or portions of a structure. A brief technical explanation of such electro-chemical action might be worded as follows:

Every metal, when placed in water or in an atmosphere which acts as an electrolyte, or in such conditions of exposure that a film of moisture may condense on it, tends to dissolve. This tendency is governed by impurities, unequal stresses and unhomogeneous nature of the metal in each case, and by the impurities in the liquid or gaseous film. Certain points in the metal, which have varying tendencies to go into solution, form electrodes of opposite nature, and corrosion takes place in proportion to the potential differences between these points, governed by the value of the electrolyte connecting them. The more concentrated the hydrogenions in a solution, (as in acids) the higher will be its electric conductivity, and the more rapid, consequently, the corrosion of the underlying metal.

It is clear, therefore, that in a fabricated structure this action between points applies not only to each surface in detail but to a whole structure of which the members are of varying composition or subject to varying stresses.

Any engineer who has experienced maintenance costs on a structure where steel sections were connected with iron rivets or bolts, submerged in salt water, will appreciate how quickly and with what disastrous results electro-chemical action will take place and violent corrosion destroy the structure.

Scale Promotes Corrosion

Owing to the process of manufacture by heat, steel plates and shapes are always coated with scale which is the black magnetic oxide of iron. This, though it has at first a metallic blue sheen, is not part of the metal, and as it is electro-negative to the steel or iron, it forms a surface which actively promotes corrosion from the moment it is exposed unprotected to the atmosphere. This corrosion is hastened in proportion to the amount of moisture in the air and any acid present.

The mill scale as it corrodes changes into a hydrated red oxide of iron holding 24 per cent. of hygroscopic

moisture which is never dried out under atmospheric heat conditions, but acts as an accelerator of further corrosion. As this change takes place the scale increases to more than double its bulk, gradually loosens and flakes off.

Paint applied on top of corroded scale, even though the oil penetrates the scale, will only retard corrosive action but will not bend the scale to the underlying metal. The paint merely acts as a covering under which the moisture in the scale will vaporize and creep. The increasing bulk of the scale as corrosion proceeds will lift the paint skin from the metal, break the waterproof film of the paint and the process of corrosion will continue. Once corrosion of the steel, therefore, is started greatest care should be given to cleaning the surface. Blue mill scale adheres so firmly to the surface that it can be removed only by the use of a sandblast or by the pickling process. Either for general work, the blue mill scale is left on and only the corroded scale which it is possible to remove by the use of hammers, scrapers and steel wire brushes is removed. Where sandblast or pickling process is not adopted to clean the steel, paint should be applied on top of the blue scale as soon as possible in order to protect it before the change from the black magnetic oxide to the red oxide starts.

Shop practice also is governed by the speed of production, the labor situation and the shapes of sections, all of which affect the amount of work which can be done on cleaning the steel to keep the costs within present practical limits.

These are the conditions governing corrosion which must be met in the successful protection of steel surfaces. It is now necessary, in order that one may appreciate the requirements of efficient painting, to say a word on the form of protection offered by paint.

Paint Must Be Versatile in Properties

Paint on steel surfaces forms a film which must adhere firmly to the steel and yet combine with adhesion elasticity, waterproofing qualities and toughness of the film. The film also must have integral freedom from impurities such that it will not permit outside elements, or ingredients in its composition in conjunction with outside elements, to form electro-chemical combinations and promote corrosion. This film must have sufficient thickness to ensure efficient life as the action of the elements causes gradual oxidation and disintegration.

Protection by a single application heavy film paint has been sometimes advocated, but in the first place it is almost impossible to obtain such a paint with toughness penetrating the film as required, combined with adhesive and waterproofing qualities, etc. In the second place, such a film would require to be applied before the steel was fabricated in the structural shops in order to protect the steel before the blue scale became corroded and scaling started, in which cases it would probably become damaged during transition through

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the shops, transportation to the site or during erection of the structure. To arrange for it to be applied in the field after erection of the structure would entail expensive cleaning of the steel under difficult inspection conditions and trouble would certainly arise in the treatment of many inaccessible or intricate built-up sections.

Paint-makers are constantly experimenting under working conditions at their plants to develop improvements on the protection of steel, but so far no single coat paint has been developed that has given satisfactory results combined with practical efficiency.

Function of Shop Coat

The function of the construction or shop coat of paint is to prevent the start of electro-chemical action on the surface, while the steel is easily accessible and so form a base on which exposure of field coats are placed. As it is the base of all protection it should receive most careful consideration. It must be composed of especially pure ingredients which make the paint thoroughly neutral and from which all free acids have been eliminated, in order to avoid chemical action between the paint and the steel. The paint must also resist the passage of electric currents as otherwise the steel will be subject to electrolytic action. It must protect the steel against the action of moisture or gases during its transition through the fabricating shops and for a period long enough until the steel is erected as otherwise corrosion of the surfaces is started before the exposure or field coats are applied.

It must dry hard with strong adhesive qualities, and yet be sufficiently elastic to resist handling of the structure through the shops and to offer an effective surface against the extreme ranges of our severe climate with 140 degrees Fahrenheit temperature range, otherwise after a short life it will crack and allow moisture to attack the steel. It must be a light coat as otherwise when used as an assembly paint between surfaces in contact where hot rivets are driven it will burn out forming gas pockets and cause loose rivets. It should be easily spread in order that it may be worked into all portions of a built-up section without difficulty by the shop labor.

Over Exposure of Shop Coat

One of the causes of high maintenance costs in steel structures is the practice of letting a structure stand exposed until not only the field coat of paint has lost its vitality, but corrosion has attacked the shop paint and bare portions of steel are exposed, thereafter applying one coat of field paint. It should be remembered that in many cases the most effective field coat is not a proper shop or steel-surface paint and that it may not stop corrosion spreading under the surface if it is not applied on top of an anti-corrosive paint. If corrosion is far advanced on a structure, at least two coats of paint should be applied after the surfaces have been thoroughly cleaned, and the first of these should be a real anti-corrosive steel-surface paint fulfilling all the requirements of a shop or construction paint.

On top of the construction or shop coat of paint, after the structure is erected and any abraded portions have been spotted with the shop coat, there should be applied a first field or reinforcing coat. This paint is required to build up the paint film and form a reservoir life for the exposure paint, also to ensure that the shop paint which has weathered during erection of the

structure is oil primed and free from any minute checking, especially if the structure is large and has taken some time to assemble, or where it is composed of light sections the edges of which are difficult to cover with one coat of paint. This paint should be a steel-surface anti-corrosive paint but slightly more elastic than the regular shop paint.

Just as the shop coat is the base on which the paint film is built up and on which depends the success of protection against electro chemical action on the surface of the steel, so the function of the field coat is to protect the shop coat against the various conditions to which the surface is subjected during its exposure.

It is perfectly evident that such conditions as govern steel buried in the ground where the paint film is subjected to fairly uniform temperatures without sudden change but constantly to the action of moisture impregnated with mineral salts, etc., are entirely different to the conditions governing exterior atmospheric exposure where the action of the sun and frost with temperature variations of over 120 degrees Fahrenheit call for altogether different qualities of the exposure paint film.

Cost of Painting

The cost of paint materials on a new structure covering shop and field coats for highest grade work averages from one per cent. to four per cent. of the cost of the structure, governed by the weight of the members used and the thickness of the metal. The labor required to apply this paint in shop and field averages approximately twice the cost of the paint materials so that the total value of paint and labor on a structure is represented by figures between three per cent. for such structures as plate girder railway bridges and twelve per cent. for light structures such as transmission towers. These figures are so low that they are often overlooked or deemed as unimportant by the engineer in charge of work, whose mind is taken up by consideration of design, stresses and details of construction, etc. It is an oversight of this kind that usually results in the high maintenance costs that follow or the degenerating of steel structures to protection by all sorts of low priced paints because requisitions apparently cannot be passed for sufficient money to correct the original oversight.

The old slogan of the paint manufacturer "It costs no more to apply a good paint than a poor one" has been so fearfully hackneyed and seized on by the manufacturer of cheap paints that it has become worthless. The slogan is true, however, as practice has proved that in most cases first costs are not added to by the use of high-priced properly selected paints, while maintenance costs are always reduced. Further, no matter how the maintenance of steel has been neglected it is almost always possible, by careful consideration, to solve the trouble and reduce maintenance costs to a minimum.

Purchase and Application of Paints

There are one or two essential points in the use of steel paints, however, that should be carefully considered by purchasers when in the market for paint:

1. The manufacturer should always be advised of the exposure to which the paint will be subjected and if possible the nature of the paint already on the surface.

2. Paints containing linseed oil should not be applied on top of asphaltic paint as action will set up be-

tween the paint films and the protective value of both coats will be destroyed.

3. Paints containing linseed oil should not be applied over or under tar paints, as similar action will occur and active corrosion may be immediately promoted.

4. Paints should never be purchased on the basis of price per gallon as this does not give any comparison of either cost of work or service value. Comparative costs should be based wholly on service records of paint and cost of application per unit of tonnage or area.

It may be of use to have the approximate tonnage of various structures which may be covered by one gallon of paint (one coat) based on the thickness of sections:

Sections $3/16$ to $1/4$ in. thick—Transmission towers, $1\frac{1}{2}$ to 2 tons per imperial gallon.

Sections $3/8$ to $1/2$ in. thick—Light mill buildings, highway truss spans, $2\frac{1}{2}$ to 3 tons per imperial gallon.

Sections $1/2$ to $3/4$ in. thick—Medium building construction and light railway truss spans, 3 to $3\frac{1}{2}$ tons per imperial gallon.

Sections $3/4$ to 1 in. thick—Heavy building construction and railway beam spans, 4 to 5 tons per imperial gallon.

[This article was prepared for this "Efficiency Number" as a result of and in answer to an article appearing in the "Contract Record" of October 23, 1918, page 855.—Ed.]

Thirty-Seven Per Cent. of Fire Loss Caused by One-Fifth of One Per Cent. of Fires

An Analysis of Fire Waste in Industrial and Manufacturing Establishments of Ontario

By George F. Lewis*

THE extension work of the Ontario Fire Prevention League in affiliation with the office of the Ontario Fire Marshall is progressing favorably. During the last few months several meetings have been addressed in different parts of the province. Much public interest has been awakened, and enthusiasm expressed on the part of officials and citizens alike by endorsing the objects of the League and furthering the general propaganda by forming local Fire Prevention Chapters.

One-fifth of one Per Cent. of the Number of Fires Caused Thirty-seven Per Cent. of the Total Loss

During the year 1918 there were 9,740 fires in Ontario, causing a loss of \$15,673,240 constituting a daily bonfire of more than \$42,000 worth of merchandise, produce and buildings. This enormous number means that a fire occurred on an average every hour of the day and night. Analyzing the cause of this great loss and preventable waste, we find that of the twenty-seven classifications under which the causes of fires are distributed by the Fire Marshall's Department there were 486 fires during the year in manufacturing and industrial plants. The loss sustained in this particular classification from the 486 fires (five per cent. of the total number of all causes) amounted to \$7,565,322, which is more than 48 per cent. of the total loss for the year in the province.

Analyzing this particular classification further, we find that twenty fires, or one-fifth of the one per cent. of the total number for the year, caused a loss of \$5,790,557 or 37 per cent. of the total fire waste. We are thus enabled to clearly define the cause of the great fire waste of Ontario, which is a very serious reflection on the precautionary measures taken to avoid fires by our captains of industry.

Cleanliness, order and forethought, with systematic inspection, capable watchmen, automatic sprinklers and other preventive means would do much to reduce this enormous waste to a minimum.

Eighteen Per Cent. Decrease in Number of Fires During Six Months

It is a noteworthy fact that the number of fires and amount of losses in the province of Ontario during the first eight months of 1918 were much greater than during the corresponding period of 1917. It is equally remarkable that the records show that since the fire prevention propaganda was launched last August by Premier Hearst, the number of fires has been greatly reduced.

During the six months from September, 1918, to February, 1919, inclusive, there were 3,965 fires as compared with 4,836 in the same period of 1917 to 1918, showing a reduction of 871 fires, or eighteen per cent.

These results are very encouraging and should inspire those who are interested in fire prevention work to strive for greater results in the future.

Matches Cause 114 Fires in February

Of the twenty-seven classifications into which the causes of fires are divided, that under matches heads the list. Out of a total number of 708 fires in the province of Ontario during the month of February, 114 fires or 16 per cent. were caused by carelessness with matches or children playing with them.

Outside of general careless habits on the part of the public, it is a difficult problem to solve when one tries to find out the direct reason for so many fires caused by matches. In discussing the matter with smokers who are in the habit of using a great many matches it has been stated repeatedly that the quality of the matches now being sold in comparison with those formerly made is very inferior. The wood of the match, it is claimed, is rough and brittle and the heads fly off. Several instances have recently been drawn to our attention in which boxes of matches in men's pockets have ignited. If there is any deterioration in the quality of the materials that are being put into the matches manufactured to-day which add to the fire menace of the country, it is a very serious

*Deputy Fire Marshal of Ontario.

matter and one which should be immediately stopped. The manufacturers of matches should be the first to see to it that their business and reputations do not suffer by foisting upon the public inferior and dangerous matches.

Strike-anywhere matches are at best dangerous and the public is cautioned against buying inferior brands when it is found that the heads fly off or the sticks break when striking the match. It is best to buy "safety" matches—the kind that strike-on-the-box-only.

Substantial Reduction in Fire Waste During First Quarter of This Year

During the first three months of this year there has been a reduction of 363 fires equal to 14 per cent. compared with the corresponding period in 1918; and a reduction of \$1,165,227 in the amount of loss sustained.

The following resolution was introduced at the convention of the National Fire Prevention Association, by Deputy Fire Marshall George F. Lewis with the idea of inaugurating a public campaign throughout the United States and Canada in the interests of fire prevention propaganda:—

Whereas the fire waste of North America is upwards of \$300,000,000 a year and the statistics show that the greater portion of this annual loss is the result of carelessness, disorder and accumulations of combustible rubbish, and is therefore preventable, and

Whereas it is incumbent on the peoples of the United States and Canada to conserve their wealth and resources during the period of reconstruction that they

may be enabled to compete with the other nations of the world to meet the demands of commerce, and supply the destitute with the necessities of life, to the end that hunger, suffering and unrest may be appeased:

Therefore, be it resolved that we the members of the National Fire Protection Association, in convention assembled, believing that the time is opportune for launching a comprehensive and aggressive publicity campaign for the purpose of educating the people and bringing them to a realization of their rights, duties and responsibilities as citizens of these progressive and enlightened countries, and which will also tend to make them more careful and improve the sanitary conditions throughout the country.

Do memorialize the Federal government at Washington, the Dominion government at Ottawa, the state and provincial governments throughout the United States and Canada to assist financially and co-operate in the work of this publicity campaign as follows:

1. The Federal and Dominion governments to grant or appropriate such sum or sums as shall be necessary to defray the expenses of a suitable campaign of education of the public in the necessity of safeguarding property from loss by fire.

2. That each state of the Union and each province of the Dominion be requested to assist in the campaign by making an appropriation to advertise the fire prevention and clean-up propaganda in the newspapers of their respective territories.

3. That all municipalities be asked to co-operate in the work of this campaign during the week of October 9th in such manner as is considered best suited to their local conditions.

Revision of Building By-Laws Will be Means of Counteracting High Costs

Material Wasted by Lack of Knowledge of Its Properties and Factor of Safety and by Excessive Live Load Requirements

By W. W. Pearse*

REGARDING the high cost of building construction, I would say that it is self-evident that some of the following reasons will apply:

1. The high scale of wages.
2. Present price of building material.
3. Not having proper knowledge of building material which includes the proper factor of safety.
4. Live loads which buildings will never have to carry.

Referring to items (1) and (2) I would say that it is entirely in the hands of labor and the manufacturer, and, therefore, cannot be controlled by any building department.

In regard to (3) the engineers and the architects have a fairly reasonable knowledge of most of the building materials that enter into the ordinary building with the possible exception of brickwork. This material has been used for a period of about six thousand (6000) years and strange as it may seem we are less familiar with its carrying capacity and strength than that practically of any other building material. The department has been endeavoring in a small way to overcome this difficulty by having tests

made on the carrying capacity of brickwork, and we have had very beneficial results so far. We hope to continue these tests this year when we may be in a position to get a further knowledge of the carrying capacity of better kinds of brickwork. It might be well to note here that brickwork, laid in cement mortar with a small percentage of hydrated lime added thereto to make the mortar workable, has added over 50 per cent. to its carrying capacity, therefore, it seems reasonable that in drafting the new by-law proper cognizance should be taken of this fact. For large buildings the cost of the brickwork, in my opinion, could be materially reduced by the use of the above mentioned cement mortar, and I hope in drafting the new by-law that due allowance may be made along these lines. The balance of the building material, such as steel, concrete and wood have been pretty thoroughly tested and we are, therefore, in a position to draft economical by-laws for these materials but, as mentioned above, we have been in the dark while we have been attempting to draft a by-law for brickwork with the result that all by-laws are drafted with a factor of safety on brickwork of from 10 to 12, which, in my opinion, is entirely unwarranted if we had the proper data on the subject.

*City Architect and Superintendent of Buildings, Toronto.

(Continued on page 637)

Quality Surveying Methods Mean Efficiency by Improving Estimating Practices

Time is Opportune for Introduction of the Quantity Surveyor—
Prejudices to be Overcome and Features Requiring Scrutiny

By Ray R. Knight, M.E.I.C.

WITH both materials and labor at a level which has no precedent, the question of estimating for the purpose of figuring a job, or putting in a tender for work, demands closer attention than heretofore.

The practice of lumping here and there to cover possible contingencies, which may or may not be clearly embodied in the plans and specifications, bad as it was in the good old days, is now in the category of inefficiency and waste. There has been little or no improvement in the plans, and the same specifications accompany them; but there is a demand to-day for a closer figure than has been attained among contractors in the past. Not necessarily closer in respect of profits, but a nearer approximation to the real cost figure.

Conditions Make Close Bidding Necessary

Before bidding on a job, the contractor has to carefully examine the plans and specifications and make up his mind as to the character of the work, and the details involved, so as to make a careful estimate to base his tender upon. Prices are too high to stand any short-cut methods of estimating, and everything to the smallest piece of hardware counts these days. The contractor who gets the award to-day is the one who has his estimate as nearly right as possible, or who carries on his staff an estimating clerk who knows his work, and is not satisfied when taking out brick-work quantities to let the door and window openings take care of the chimneys and "them piers".

This article is a brief for the quantity surveyor, that more or less unknown genius in this country. It is not the good fortune of every contractor to count on his staff a quantity surveyor, but there is a method by which the contractor can have at the clients' direct expense, the services of a qualified surveyor, whereas by the present method the client is charged by the contractor in his overhead for the services of his estimating clerk.

Time is Opportune for Introduction of Quantity Surveying

The method by which this can be brought about is the establishing of the profession of quantity surveying. Against innovations there always is a decided stand taken for the old-time methods; and when this subject was broached in the past it met with disfavor, and its authors with failure. Let us make the excuse that the contractors were all too busy, and times too good to bother with something that needed time for consideration. Such, however, is not the case now. No contractor is squealing about being overworked just at present, and if he will take time to consider or reconsider, as the case may be, a question of such vital importance, it may be that the time will be found to be ripe for introducing into the most important forms of construction work the Bill of Quantities.

The points to consider in this regard are more on the advantage side than on the disadvantage. The

most important argument for the bill of quantities is that it gives to every bidder exactly the same information as to the interpretation of the plans and specifications; and provided the bill of quantities is legally incorporated with the plans and specifications and forms part of the contract, there can be no doubt as there often is now, as to the intention of the architect. This alone is an asset of priceless value, not that it is the intention here to suggest that architects by their plans and specifications, purposely mislead; in fact it is quite the reverse. But careful as an architect may be, and go into detail as thoroughly as he may, there are always the few items that leave the contractor in doubt as to the real intention. The greater percentage of this doubt is eliminated by the bill of quantities, because anything that goes to make up the building must be mentioned in the bill, and space is provided for the contractor to price the item.

Cost of Bidding is Reduced

The second point to consider as favorable to the bill of quantities is that of cost. Under the present system each contractor pays his own estimating, so that if ten bid on the work, there are ten sets of expenses paid for taking off a bill of materials. This the contractor pays out as overhead and when fortunate in securing a contract, receives from the client a percentage figure, and so pays for his overhead expenses. In the case of the bill of quantities the quantity surveyor is the only one paid, and his fee is such that it adds no burden of cost on the client beyond what would ordinarily be figured for such work by the contractor. Only one tender can be accepted. The other nine contractors must charge the expense of preparing the estimates for lost tenders against the successful ones. Moreover, it is a poor system that involves so much wasted energy.

Chance of Omission is Eliminated

A third point for consideration is the chance of omission. Many a contractor has been placed in a difficult situation on account of an omission from his estimate of items, even one item perhaps, of sufficient importance from a cost standpoint to mean a direct loss. This, of course, can be put down to carelessness or inefficiency, but to err is human, and such discrepancies will always occur especially when the time is limited for the presentation of the tender. With the bill of quantities before him a contractor has little chance of leaving any item out. He may make an error in pricing, running out, or casting, but there is no excuse for omission. And should he make a clerical error it is evident on the face of it, and in justice to the contractor he should have the opportunity to correct such an error before his tender is accepted or otherwise.

Many other minor, but not less important points, can be brought to notice for consideration, but in dealing with the main features, sufficient argument is set

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forth to justify the necessity of the introduction of this important adjunct of correct construction.

Points have been raised as to the disadvantages of quantity surveying; and it is intended to mention the more familiar ones.

There is a feeling entertained by some architects that the bill of quantities for works adds to their cost. Beyond the undeniable justice of the provision of the bill there is the uncontrovertible evidence from those who have been accustomed to the system against such a feeling being well founded. If work is to be well done there should be no doubt at the start as to the real intention of the plans and specifications. There is nothing which tends to bad workmanship and poor materials more than an attempt by a contractor to recoup himself for losses due to errors in the original estimate. The liability to error is considerable and particularly so in cases where the persons preparing the estimate are not well experienced. Furthermore, there is nothing so fruitful in adding to the figured price of work than an uncertainty as to what is required.

Another prejudice to be faced is that against the so-called elaboration which is introduced in the bill. In a proper bill of quantities there should be no elaboration. Only such items as call for a price either of labor or material are mentioned, and the contractor is free to price them or not as he feels disposed. The character of the work should be the basis upon which the quantity surveyor should regulate the amount of detail he includes in his bill. To the contractor who suggests that the number of items in a bill adds to the tendered amount, it should be said that the day for rough methods of estimating are over. The up-to-date contractor who keeps a cost system will appreciate the inclusion of every item in a well regulated bill. He knows what they mean and how important they are.

Create a Standard to Govern Quantity Surveyors

A still further objection is raised on the ground that systems of estimating vary in different localities. This is undeniably true, but with the introduction of a system, this objection can be met by creating a standard by which the quantity surveyors in this country would be governed.

Let us then face the facts as they present themselves. Providing the time is ripe, and the writer knows of none better than the present, there should be no hesitation on the part of the contractor in demanding this service from the architect.

It is well here to mention that the architect has been referred to throughout this article. The engineer also comes within its scope as his work is largely akin to that of the architect. One exception should, the writer thinks, be made, and that is where work is essentially underground, such as sewer work, involving, as it does, so many divergent details of construction. The reason for making this reservation is that experience has shown that no two contractors will adopt the same methods for timbering trenches, tunnels, shafts, etc., so that the quantity surveyor cannot be in a position to give the exact information as to measurements for this work to suit all contractors. In order to put the matter on a proper footing, our colleges should undertake instruction along predetermined lines, but it is only reasonable to assume that before the college would undertake this work there must of necessity be a demand created for the person called the quantity surveyor.

How is this to be overcome? The writer knows

there are many men in this country who practised in the profession of quantity surveying in the mother country, who would be in a position to form a nucleus of that profession in this country, locating in the larger cities. The present day estimating clerk of the contractor's staff would be available also.

Placing Machinery in Motion

A little enterprise is needed in order to put this important piece of machinery into motion. There is no doubt in the writer's mind that the bill of quantities would be appreciated by the contractor, and if detailed along predetermined lines according to customs generally adopted, should offer no difficulty in the matter of pricing.

It would be interesting to know what the feeling of architect, engineer, and contractor are with regard to this method of estimating. There is nothing new in the preparation of a bill of quantities; the only novelty is its general introduction to Canadian construction.

The essential feature, however, is that proper standardization of methods should be adopted throughout the Dominion, regard being given to the generally accepted methods of measurement and description. Economical methods are necessary in order to reduce overhead costs which, added to present high prices, make construction work somewhat of a luxury, except to the larger and highly capitalized few. The bill of quantities is undoubtedly an economic measure, and one that has behind it the hall-mark of justification. The bill gives the contractor, the architect and the client a square deal, and once its adoption takes effect, the competitive basis of tendering is reduced to a question of prices for certain works, and not a guessing bee.

One Feature Requiring Scrutiny

One feature of the bill of quantities needs careful scrutiny at the outset. The habit of placing provisional amounts for certain particular works, with instructions to the contractor to add profit, labor, etc., can be overdone. There should be as few controlled items as possible in a bill, so that competition in purchasing as well as the other branches of the contractors' organization may be given scope. The unit schedule for additions or omissions may of necessity form part of a bill of quantities, and an element of judgment often enters here to the advantage of a shrewd bidder, who can foresee that certain quantities given in the bill may be varied owing to local conditions such as contour of site, etc. Some bills, however, do not include a schedule of extras or omissions, and stipulate that such shall be added or deducted according to the unit price set out in the bill. The writer does not feel disposed to say which of these is the fairer method, but recommends that an important feature of this kind be decided before embarking on the general use of the bill of quantities.

The quantity surveyor also acts as mediator and sometimes an arbitrator between the contractor and the architect in the event of there being a variance from the plans. Being entirely an independent party he is probably the best qualified to act in this capacity. His knowledge of the work and costs will assist him in arriving at a decision which will be fair to all parties.

The quantity surveyor is an accepted fact in Great Britain and has proved his value without doubt. The United States is fast coming under his influence. Why not Canada?

Efficiency in Industry Maintained by Better Ways of Lighting

"Daylight" Installations Minimize Accidents Due to Faulty Illumination and Provide a Means for Increase in Production

By J. A. Findlay*

IT has been observed that a large number of industrial accidents occur in the winter months, especially in the afternoon—the time when artificial illumination is necessary. No doubt many mysterious accidents are directly due to the defects in lighting. From the standpoint of accident prevention, according to a bulletin used by the Department of Labor and Industry of Pennsylvania, one of the most important manufacturing states to the south of us, the value of adequate illumination is important. The Traveller's Insurance Company estimates that about 25 per cent of avoidable accidents are due directly or indirectly to poor lighting. The Departmental Committee of Great Britain on accidents in factories reports that inadequate lighting is a very frequent cause of accident and of grave dangers.

In order to promote and maintain efficiency and

gave a study to the factor of natural light, and the results of their investigations satisfied them that in terms of industrial efficiency this construction would pay them big dividends. The results have satisfied their beliefs.

The effects of working in such a building is equivalent to remaining outdoors, and being at the same time, sheltered from inclement weather. To work in that atmosphere of abundant daylight and fresh air all day long is to be given the nearest approach to an outdoor life that is possible for indoor workers to secure.

"Daylight" Installations

Some of the recent Canadian factories that embrace examples of real lighting, might be mentioned. The new plant of John Bertram Sons Company. This plant has every nook and corner lighted, both with side

An example of excellent factory illumination



economy in the industrial world and to minimize the hazards to health from faulty illumination, it is necessary to give the same serious study to the problems of illumination as has been given to such other phases of industrial hygiene as ventilation and sanitation.

The Window-Walled Factory

In many plants installations of steel windows which replace with their lighting areas from 70 to 90 per cent. of the wall space formerly given over to dark, confining walls of brick or stone, have proved the most economic and practical method of industrial lighting, and the window-walled factory is now a common sight in every locality. Imagine for instance a single window of 14,000 square feet of steel and glass. Such is the construction of the side walls of one of the New York Central Railway's shops. It was not for appearance, either that such a construction was adopted by those practical-minded railroad engineers. They

wall steel sash and continuous sash of a type that, no matter what the elements are outside, these sash can be opened for ventilation without any danger of rain or snow blowing in. Another example of real lighting, is the new No. 6 factory of the T. Eaton Company, Limited. They have here four walls that are practically filled with steel sash. The result is that everywhere you go in this building you get adequate lighting. A plant much smaller but embodying all the features of those larger plants, is that of the Dominion Steel Products Company at Brantford. Very recently also we saw a photograph of a garage building in a large U. S. city. The garage was so situated that the only place light could be obtained was at the front. Windows could not be installed in either side or the end although the garage was a very large one, a roof design was used of such a nature that the continuous sash extended over a very considerable part of the top of this garage, and it was splendidly lighted.

Another very noticeable example of a daylight

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plant, is that of the Consolidated Press Company at Hastings, Michigan. As one approaches the building, he is immediately impressed with its unusual appearance, the exterior consisting of white enamel brick, with broad areas of glass. The management sought to build a factory that would be inspirational to all who view it, and especially to the workers within its walls. The sash used in this daylight plant are of a type suspended from the top, and floor operated. The roof is a special type. The machine shop is roofed with cement tile, the other buildings with gypsum tile, all being covered with felt and gravel roofing. Artificial lighting is supplied by high intensity lamps placed near the roof and so out of the line of vision. The lighting was figured on the basis of $3\frac{1}{2}$ candlepower on a 30-in. plane. The lamps used vary in candlepower according to their location, and are distributed to insure an evenly diffused light. The machine shop is entered by two railroad tracks, the openings protected with rolling steel doors, and by another which traverses all the buildings and brings castings from the foundry.

Canada has been somewhat behind our neighbors to the south of us but natural daylight has proven itself to have so many advantages that our manufacturers, architects and engineers are going even one better than our U. S. friends and are working out ideas in connection with natural ventilation and lighting that are without equal in any part of the industrial world. Ventilation, of course, is absolutely necessary, as well as lighting, and with continuous sash operated in long rows either by hand or by small motors, good fresh air is throughout the plant at all times.

We have come to a time in our industrial history where these matters must be studied very closely in order to make the most of the opportunities that await us, both in this country and abroad. Sir Thomas White in presenting his recent budget tells us that our salvation is in producing and saving. He says as follows: "Our ability to meet and retire our war obligations will depend upon our power to increase our production of natural and manufactured commodities and to economize individually so as to bring about each year substantial increase in domestic wealth and saving and a more favorable balance in our international trade. In other words the motto for the future as it was for the war must be "produce and save."

Dealing with saving, the use of steel and hollow sash in factories eliminates absolutely the fire travelling from one building to another and a very large percentage of our fire hazard has been from this cause. Harping back to the Toronto fire in 1904, if the premises then occupied by Brown Bros. and by W. R. Brock Company had had steel sash in them, in place of the wooden sash, the fire would never have reached across Wellington Street or have amounted to 25 per cent of what it did.

Canada's fire loss is greater than that of any other country per capita. In April last we burned up \$850,000 of buildings. Last year we burned up over \$32,000,000 and since Confederation we have burned up over \$700,000,000. And quite aside from the financial aspect of the case a large proportion of industrial unrest can be eliminated by buildings that are comfortable and proper to work in.

Testing and Inspection as a Means of Safeguarding Construction

The Duty of the Testing Engineer in Detecting Faulty Materials—The Usual Tests for Concrete and Steel

By R. Robertson Deans*

IT may be said that the life of a structure depends primarily upon these three points, viz., the design and specifications, quality of material used and workmanship. Engineering, like other professions, is divided into several branches, each specializing in some particular line, for example, the design of a structure lies within the province of the designing engineer or architect, the inspection and testing of materials of construction belonging to the inspecting and testing engineer and lastly, the construction with the contracting or construction engineer.

As a protection to the owner, his engineer, architect or contractor it is most essential to know that the materials used are of the best quality, in accordance with the specifications and suitable for the structure. It is sometimes said that the contractor is responsible for failures due to faulty materials, and if by using inferior material, the structure should show itself defective, he is required to replace it at his own expense. A moment's consideration will show how unfair this is to the owner. Cases have been brought to my attention in which structures have failed after completion, thereby involving much expense and inconvenience, whereas, by thorough testing and inspection before and at

the time of erection, all this might have been avoided.

To specify that the "best Portland cement" must be used is not enough, although such a description is far from uncommon. To insure absolute dependence on the strength and durability of concrete, it is imperative that the quality of the cement, aggregate and reinforcing steel be determined by thorough testing and inspection.

Cement.—In order that the contractor may not be held up awaiting the results of tests on cement, sampling should be done at the point of manufacture by the inspecting and testing engineer's representative, so that should the contractor desire to use the cement on short notice, the results of the twenty-four hours and possibly the seven days' tests would be in his hands before the cars reach their destination. Samples should be taken from the cars at the time they are being loaded and from every fortieth bag or tenth barrel, thus taking a true representative sample from each car. The cars should then be sealed with the inspection company's private stamp to assure their client that the cement has been sampled by them. The samples are then forwarded to the nearest laboratory of the inspecting engineer and put under test. These tests consist in the determination of specific gravity, fineness, nor-

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mal consistency and time of set, constancy of volume and tensile strength, all tests being carried out in full accordance with the specifications of the Engineering Institute of Canada, the American Society for Testing Materials, the British Standard Specifications, or any other standard specifications.

Fine Aggregate—Samples of sand representative of the material to be used should be submitted for test prior to the commencement of the work, the recommended tests on sand being: weight per cubic foot, and percentage of moisture on the material as received on the work; silt and organic matter; mechanical or granulometric analysis (in this test not more than 35 per cent. of the material should pass a sieve having fifty mesh to the lineal inch, and not more than 10 per cent should pass a sieve having one hundred mesh to the lineal inch); specific gravity; percentage of voids; and tensile tests (made on mortars composed of one part of accepted Portland cement and three parts of fine aggregate by weight, shall develop a tensile strength 100 per cent of the tensile strength of concrete of the same consistency made with similar proportions of the same cement and standard Ottawa sand); also microscopic examination to determine the general conditions of the material and whether the particles are coated with clay, dirt, etc.; and volumetric test.

Coarse Aggregate—Consisting of coarse inert material, such as, gravel, crushed rock, etc., retained on a sieve having holes $\frac{1}{4}$ in. in diameter. The particles should be graded in size, clean, hard, and free from all deleterious matter. Representative samples of the material should be submitted to the same tests as for sand, with the exception that compression tests should replace tension tests. Concrete, composed of one part of accepted Portland cement, two parts fine aggregate and four parts coarse aggregate and gaged with sufficient water to give a quaking or medium consistency, should develop, at the age of twenty-eight days, an average compression strength of at least two thousand (2,000) pounds per square inch. Test specimens should be made in the form of cylinders six inches in diameter and twelve inches high. Failures in concrete investigated by our company have often been found to be due to the use of defective sand or gravel, which might have been prevented by a judicious test of sand or gravel before using.

Reinforcing Steel—On account of reinforcing steel being rolled from various grades of steel billets, old rails, etc., some of which are undesirable product, and taking into consideration that elasticity is the governing factor, it is necessary that thorough inspection be made. In order to determine if the steel has a high elastic limit, without any tendency towards brittleness and in accordance with the engineer's or architect's specifications, complete physical tests should be made for elastic limit, ultimate tensile strength, elongation, reduction of area and bending tests; also complete surface inspection of the material.

Field Inspection—Particular attention should be given by the inspector to the work, striking of centres being checked up, also the placing of the forms. The concrete must be mixed by a machine of a type approved by the engineer or architect, and must be mixed until each piece of aggregate is thoroughly coated with mortar, care being taken to provide the proper amount of water necessary to obtain the desired consistency, so that the concrete will be uniform. In small batches where the concrete is mixed by hand, the cement and sand would be made into a mortar by mix-

ing them dry until the cement is so thoroughly distributed that no particles of sand can be detected, being completely covered with cement, and then adding enough water to bring it to a plastic state, after being thoroughly worked. The coarse aggregate is then drenched and drained and mixed well with the mortar until each piece is completely coated.

The proper proportioning of the cement, sand and stone is an important factor. Therefore, materials are frequently checked before going into the mixer. When the concrete is ready for placing in the forms, it must be of a medium or quaking consistency, and after placing shall be puddled to free any air bubbles or eliminate bridging of the larger particles which might form air pockets; spading should be done between the concrete and forms so as to give as smooth a face as possible to the concrete when the forms are removed. Concrete which is reinforced with steel reinforcement bars or surrounding beams, should be of proper consistency but not sloppy and worked well to insure complete encasement of the steel, care being taken not to displace the reinforcing steel. The method of delivering and placing concrete should be done to the approval of the engineer or architect, and such as to insure a perfectly mixed concrete at the point of delivery.

The placing of reinforcement bars is checked with the drawings. All concrete must be protected from the direct rays of the sun in warm weather and should be kept moist for a period of forty-eight hours. No concrete must be laid during freezing weather unless protected from frost by some approved method.

Field Test of Concrete—Samples of concrete as it is mixed should be taken daily or as often as the engineer or architect may desire and moulded in standard cylindrical forms, which should be tested at the age of twenty-one or twenty-eight days and the compression load in pounds per square inch recorded.

Specimens should be properly marked for future identification and stored on the work under the same conditions affecting the concrete that the specimens represent. Records of the compression strength of concrete gives most up-to-date and complete information as to the actual strength of the concrete and is also a protection to the owner, Engineer or architect and contractors. Test specimens should be made in duplicate and before removing the forms, one specimen being sent to the laboratory for compression test; should the first specimen fail, the second will be tested at a later date.

Steel Structures

Mill Inspection of structural shapes for steel buildings is equally as important as the inspection of structural steel for bridges. In order to ascertain that the steel conforms to the specifications. If accepted on chemical tests, the rolling of the steel should be carefully supervised, specimens being cut from the finished material as directed by the inspector, (stamped for his identification with his private stamp) on which the physical tests should be made, consisting of elastic limit, ultimate tensile strength, elongation, reduction of area, showing character of fracture, also bending or drifting tests. If the material meets the requirements of the specifications for physical tests, careful examination should be made for surface defects, and on acceptance of the material, the inspector should stamp same with his private stamp so that when the material

arrives at the building site, the engineer or contractor will be able to identify it by the inspection stamp.

Shop Inspection—Inspection during fabrication of the steel is most valuable as it is then that defects can be most easily seen and remedied. After the material has been marked from templates, it is the inspector's duty to see that the punching is properly done. On the materials being assembled, the holes must be properly drifted and show themselves well matched with no obstruction. Should any inaccurate punching be discovered, it must be altered so that it will clean up to perfect right angles. Prior to reaming of the material, where same is mentioned in the specifications, sufficient bolts should be put in the several members so assembled so that when riveting is taking place, there will be no cause for replacement. At the time the members are assembled and reamed and being riveted, it is the inspector's duty to go over each and every rivet, seeing that the heads are hemispherical and in full contact; that they are concentric and completely fill the holes.

Castings and Cast Columns—In this class of work the inspector should be at the foundry during the time that the material is coming through. He should supervise the casting operations, also see that the material is of such a nature as to give a casting free from flaws and contain no mixture of sand, scoria, or other impurities. To be certain of this, frequent tests are made on the material and if considered necessary a chemical analysis should be determined on the material. Test bars should be cast on the castings on which either tension or transverse tests should be made. Stripping and cleaning operations should be carefully examined, this part of the work being most essential as, if the castings are removed from the moulds while showing any color of heat, they are subjected to a chill which induces either internal or external strains on the metal. After the castings have been thoroughly cleaned and accepted on the physical tests, they should be carefully examined for defects, such as, blow holes, blisters, etc. In cast columns, particular attention should be paid to the lugs and other connections to see that they are of good workmanship and in full accordance with the drawings and specifications.

Field Inspection—In the inspection of structures on the field, all construction operations should be supervised, paying particular attention to the laying out of the work, lining and plumbing of columns, riveting, painting, erection of forms, pouring of concrete, striking of centres and stripping of moulds. On buildings the inspector should be permanently located at the job from start to finish and should be fully competent to supervise complete construction operations.

Asbestos as an Efficiency Material

*Its Value, When Used in Roofing and Sheathing,
in Keeping Down Country's Fire Loss*

CANADA has the unenviable record of having the biggest fire loss per head of population in the world. This may look like good business for the builder. In actual fact, however, every fire means a dead loss to the country, and just in proportion as our nation is poorer, so are we less prosperous and our contractors are less prosperous. There

is no item of expense in our national life that could be so easily curtailed or would work more immediate or greater results than this useless item of fire loss.

Within very wide limits fires are preventable, and one of the surest methods of prevention is the use of materials that will not burn readily. That is why asbestos materials in building are making such headway. Primarily designed to replace the ordinary roof coverings only, its merits have been found to be such that its employment by our best architects and engineers has extended to all classes of work wherein its many desirable qualities have supplanted other materials heretofore commonly in use.

It is perhaps superfluous to say that asbestos shingles, slates or sheathing, made wholly of mineral fibre, asbestos and hydraulic cement, are both fireproof and indestructible. Asbestos, or mineral flax, as it is often called, from its peculiarity of crystallizing in fibres instead of ordinary crystals, as is the usual case with mineral materials and hydraulic cement, have been known, from earliest times, as among the most refractory of substances. The old Greek and Roman remnants of antiquity, composed largely of hydraulic cement, remain mute witnesses of the everlasting quality of this material.

The Value of Asbestos

Asbestos fibre has remained exposed to the elements for unnumbered centuries, without deterioration. Its well-known fireproof quality renders it the most suitable fibre upon which to crystallize the cement deposited thereon in the course of manufacture. It is therefore evident, from the well-known qualities of these two materials that nothing could have been selected that would have been more fireproof, indestructible and everlasting than asbestos fibre and hydraulic cement as raw materials from which to prepare a permanent building material such as asbestos shingles and asbestos building lumber. Nails may be driven through asbestos shingles and asbestos building lumber by a quick, sharp blow of the hammer, quite close to the edge without danger of fracture, thus differing materially from all other sheathing materials in the important attribute of toughness and homogeneity.

It is sufficiently elastic to allow of marked tension due to vibration, expansion and contraction of surrounding parts, wind pressure, etc., without cracking or breaking in any manner. Shingles may be punched, filed or worked generally with the greatest ease, with ordinary tools such as are used for working natural slate or wooden shingles. They become very hard, particularly if exposed to the weather or after the lapse of years. One great and desirable feature of them is that they can be successfully jointed, fitted, etc., by the work of ordinary mechanics, no unusual or special knowledge being required in handling them.

They can be used upon nearly every class of structure where there is sufficient pitch of roof for the ordinary use of wooden shingles or natural slates. Architects who are desirous of securing an uneven appearance in the color of the completed roof are specifying that the asbestos-cement shingles be laid haphazard right and wrong side up, which especially in the solid red color makes a very attractive roof.

With the ample supply of modern fireproof building materials there is no reason why Canada should not show a marked and immediate improvement in her fire record. National efficiency demands it.

Building During the Reconstruction Period

Familiarize Public With Cost Plus Contract and Establish Confidence in the Scheme--Construction Held Back by Heavy Contingency Items

By Joseph Banigan*

THE war induced an excessive centralization of economic and industrial functions in the hands of the Government. This war-induced centralization dramatized for us the essential fallacy of substituting the politician for the engineer, executive and business man. These terms are used to express men functionally fit for the job in hand. In much the same way the results of the war have demonstrated that socialism is unsound, because this, too, means a great centralization of economic and industrial functions in the hands of the state. Most of us believe that business should be handled by business men not by politicians. Briefly, in a modern democratic society, we simply do not dare to put all our eggs into one basket, which basket is to be carried either by the bureaucratic politician or the autocratic business man. It seems to be the consensus of opinion that we have not to choose between the unsocial individualist or an unsocial bureaucracy, but there is, judging from expressions in articles and talks, a growing opinion that industry and business can be organized on a basis which will give adequate protection and voice to all classes involved--the employer, the employee and the consuming public.

If this opinion is sound, it seems, therefore, that labor is demanding, and will demand with increased success, a larger share in both the profits and management of business and industry. The unrest and uncertainty of the business world, and particularly of building trades, is due to the fact that we are not able to answer questions, such as, what changes in the fundamental organization of business and industry will the demands of labor necessitate. Will increased participation of labor in the control of business make for greater or less efficiency? Will it raise or reduce the total profits? Will the wise employer oppose the demand or will he join with his employee, work out a new organization of productive and distributive machinery of a large nation, that will mean an increase in equity and efficiency in business? Does all this mean a 'class war' or is there a feasible co-operation of the classes? Do not these questions cut to the heart of the unrest that now exists?

Building Trades Differ from Other Industrial Trades

The building trades are in reality factories which have a single product, the building, and after the completion of the product, they become disorganized, broken up into parts, reformed into another factory with another single product. This makes it more difficult for contractors to consider any of the much proposed schemes of co-operation, such as the Whitley Council or the International Harvester idea, and makes the unrest among labor in the building business much greater than in more organized industries. From the standpoint of the investor, or capitalist, the building is usually only part of his total investment. He is, therefore, very much worried about what is termed 'the excessive building cost,' without realizing that the majority of building pro-

ducts have not increased in price in the same ratio as other materials, like wool or cotton or machinery, due to the fact that building, as an industry, was reduced to very small proportions during the war. In addition, the price of building materials, with the exception of steel, during the early part of the war, dropped to unprecedented low levels. Comparing the existing building prices in the late 1914 and early 1915 there seems to be a tremendous increase, but the ratio between 1913 and 1914 prices, with the existing quotations, do not show any increase as great as has been realized in other lines. There is also a very great exhaustion of stock of building materials and a prospective large building programme. These factors would seem to indicate an increase of building cost, rather than a decrease and therefore it is the opinion of many contractors and architects that there has been much idle talk in the newspapers of the prospects of decreased building cost, which will not materialize.

Briefly then we are facing a period of increased construction with an increase of prices and a labor unrest which is more difficult to satisfy by the contractor, due to lack of a more complete organization among the building trades and the inherent lack of stability and permanency in the contractor's organization. There is also among investors an opinion that prices will decrease.

Familiarize Public With Cost Plus Contract

What, therefore, should be the attitude and method of combating these conditions in order that prospective construction may proceed as soon as possible? It seems that the contractors should, like most progressive business men, endeavor to answer, and propose some scheme for the increased participation of labor in the control and profits of the business, because this subject touches the fundamental unrest of the period. More particularly it would seem that a concerted effort should be made by the building trades to educate the general public not to expect a decrease of building costs and to a greater familiarity with the advantages of the cost plus contract and the cost plus a fixed sum have been enumerated many times. In general they are: (1) better work, (2) increased business for those contractors who conduct their cost plus work on an honest, fair basis, (3) a lessening of the cost of estimating for jobs not secured and (4) the building up of a clientele upon a basis of service rendered.

The advantages of a lump sum contract are that the capitalist knows the exact cost of the building ahead of time. The disadvantages are the disagreements which always arise over 'extras,' and which will continue until a perfect set of plans and a perfect set of specifications by the perfect architect and engineer can be obtained; the fact that there is considerable loss in figuring upon jobs not secured; and the tendency that the man who has made the greatest mistake, and has therefore the lowest figure, secures the job. This fact causes the tendency to scrimp and

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save money by the contractor, at the expense of the quality of the building.

Adding Large Sums for Contingencies

During the reconstruction period the labor unrest and the prospect of increased prices is causing all contractors to load their estimates with an unusually large sum for these contingencies. It is our belief that this necessary factor is holding back the building trades. If it can be clearly shown to the investigating public that they can reap the benefit of these uncertainties at the expense of taking a certain risk and that these savings will be considerable, much increased building will be the result.

Large numbers of contractors are refusing all contracts which are not upon a percentage basis or cost plus-a-fixed-sum basis. There is, however, a combination of the lump sum and cost plus contract which seems to fit the present conditions admirably and should be strongly advocated, namely that tenders should be called for on the lump sum basis, and then a contract should be written as a cost plus-a-fixed-percentage with the guaranteed price of the lump sum tender. If the cost-plus-a-fixed-percentage is less than the upset price, the difference should be shared between owner and contractor on the basis of one-third to the contractor and two-thirds to the owner.

Establish Confidence in Cost-Plus Scheme

If it can be demonstrated by collective information that on the whole the owner has made an appreciable saving in the cost of building under this method, while taking none of the risks as under a straight cost plus contract, it will at once establish a confidence in a straight cost plus contract which will grow as the demonstration is more frequent and convincing.

I therefore plead to the contractor to consider and

advertise the cost plus contract with an upset price and a division of the saving, for the following reasons: (1) It assures the owner of what the maximum cost of his building will be; (2) it gives the owner part of the benefit derived if the labor unrest and uncertainty of prices of materials is not as great as anticipated; (3) it gives the contractor a fixed percentage and assures him of an additional profit for the risk he takes and, in general, this form of contract has the effect of stabilizing the business of construction by giving the owner accurate information as to cost and does away with the idea that the contractor is making excessive profit, or that costs are excessive, and places it on the actual basis that in underwriting the uncertainty of this reconstruction period, the contractor is entitled to some extra profit. The owner is entitled to receive back some portion of the saving when the costs of materials and labor have not increased as much as they anticipated.

Such slogans, as given herewith, if used for advertising purposes, might be effective in educating the public to the fact that it is as opportune to build now as later: "Build now—It will cost more later." "Building prices have not advanced as much as wool, cotton, machinery." "Building costs will return to 1910 prices only when all other prices get back to that level." "This is the era of high prices, good wages and fair, honest returns; the good of Canada demands that needed building proceed." "More production, not cheaper prices, is the need. Build now."

The writer suggests that the builders' exchanges and architectural associations should co-operate in a campaign to inform the public of the benefits of building now, and also to bring about the more general use of the cost plus contract with an upset price, leading to the general adoption of the straight cost-plus systems.

Efficiency in Utilization of Electric Power

**Simple Improvements Reduced Power Bill \$3000 Per Annum
—Capital Cost of Alteration Less Than Two Months' Savings**

By A. L. Mudge*

THE following are typical examples of improvements in electric light and power systems in large industrial establishments, and indicate the possibilities of what may be obtained in many other cases:

Reduced Power Bill \$3,000 Per Annum

A manufacturer using about 400 h.p. was penalized by the power company on account of low power-factor. The power consumption of every motor in the plant was tested and many motors were found to be too large. Several motors were loaded to less than 20 per cent. of their rated capacity. Drives were re-arranged, four motors released—and sold for more than enough to pay total cost of changes—and annual power bill was reduced by \$3,000.00. Further, a goodly portion of the power company's stations, transformers, and lines was released to carry other important war demands for power at a time when such capacity was very badly needed.

Two Months' Savings Paid Capital Cost

A manufacturer in Toronto with motor installation of 3000 h.p. was using about 1400 h.p. supplied from

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sub-station three-quarters of a mile away at 550 volts. Due to war conditions, load had grown very rapidly till there was a loss of about 400 h.p. in line and an excessive voltage drop frequently to below 450 volts, as shown by the inner curves in the accompanying chart.

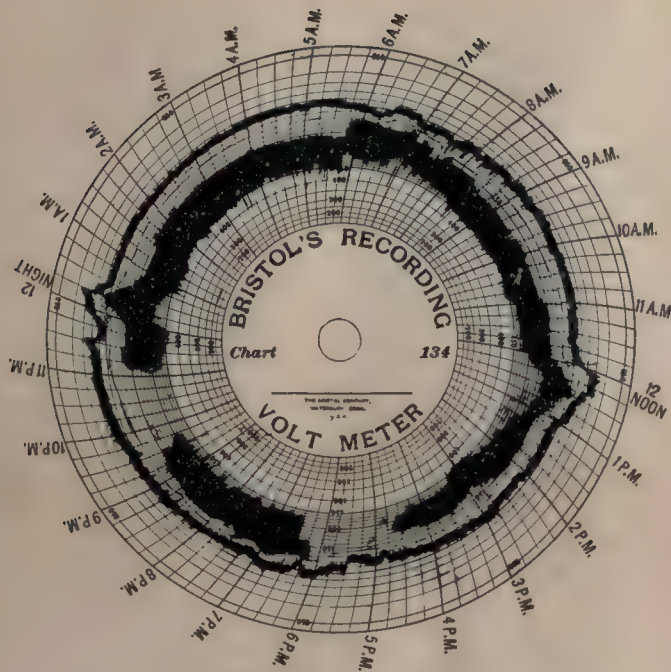
This caused the following conditions in factory:

1. Motors would overload and heat excessively, making it necessary to shut down for cooling and repairs.
2. Motor fuses would blow and shut down motors.
3. Main circuit breaker would open and shut down entire factory one or more times per day leaving 1,500 men idle.
4. Motor load going off caused excessive voltage rise. In one day this resulted in burning out \$64.00 worth of lamps.

The switching arrangements at the centre of distribution were also very inadequate and dangerous.

The work done consisted of:

1. Examining entire electric power system of factory making tests of power consumption, power-factor, etc.



Improvement gives a higher and better regulated voltage

2. Making analysis of power bills and operating conditions.
3. Negotiations of new contract with power company.
4. Design and construction of 2,000 h.p. sub-sta-

tion at factory to which, under the new contract, power company delivered power at 12,000 volts. The power company was able to loan transformers to the manufacturer on account of transformer capacity released due to the changes.

5. Purchase and installation of new 8-panel distributing switchboard.

6. All change-overs were made during usual week-end and holiday shut downs, causing no interruption to production.

The results obtained were:

Continuous service at steady normal voltage; see outer curve in the accompanying figure. This means the elimination of all the troubles referred to above, and gave an increased production of many thousands of dollars per month. It is interesting to note that with an average closely regulated voltage of 600 at sub-station, instead of 500 volts badly regulated, motor speeds will be 2 per cent. higher, giving both increased production and better quality of work on account of higher and steadier speed.

2. Safe and satisfactory handling of load through new switchboard with ample provision for extensions in future.

3. Entire capital construction cost comparatively small, being less than amount of the savings which resulted during the first two months following change-over.

4. Practically all of the 400 h.p. line loss was released for use elsewhere when war demand for power was very heavy.

Quantity Surveying—Its Relation to Greater Efficiency

Elimination of Duplication of Effort is First Principle in Contractor's Endeavours to Handle His Work More Economically

By Edward H. Beck*

THE usual routine of an efficiency engineer is first of all to make a very exhaustive study of the nature of the work which he has to classify and possibly re-organize, and in this study he has to take into account every minute detail which can possibly be connected with the work. He not only has to trace and classify each movement, but must decide as to the necessity of each movement, and has to eliminate all unnecessary work, such as the duplication of certain movements, etc.

In efficiency work it is absolutely of no use to start at the wages of the workers; one must study the job and the nature of the materials used, and from this information decide as to what wages the job is worth.

Working From the Wrong End

Today we are confronted with very serious strikes, and it seems that wages are to go still higher, which will make the cost of living still more than it is today, and yet the men are striking because their wages are not sufficient to take care of the high cost of living. Does not this point to the fact that we are tackling the proposition from the wrong end? The writer is an employer of labor, but has to admit that the workers have very strong cause for dissatisfaction with their lot, and is of the opinion that we shall get no lasting results

until every industry gets after the proposition from the efficiency point of view, and not only makes a real effort to get rid of the duplication of work, but also the duplication of, or excess of profits. It is not by appointing political commissions for this work that success will be attained, but by the employment of expert efficiency and industrial engineers, backed up by the government with all the power needed. It sounds like a big job, but this is a big country, and surely we have big enough men to handle the work, and engineers as a profession are never happier than when up against a real big proposition. Just as an illustration of my meaning, take the case of the brick manufacturers. We are now paying from \$16 to \$19 per thousand for bricks that were fetching \$9 to \$10 before the war. The clay costs no more today than before the war (excepting the higher wage), coal and wood are higher also due to the higher wage; but this is not 100 per cent or anything like it. What then is the high price due to? The manufacturer says that he is justified in charging a higher price owing to the shortage. Is he? Here then is one of the reasons for the high cost of living. Eliminate the excessive cost, and not add to it by increased wages.

Through tackling the proposition from the wrong end, and through the medium of these costly strikes, all

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wages are today unbalanced. Let us get busy and classify, and where necessary re-organize, thereby not only benefiting ourselves but also those who look to us for the wages docket.

Between the Devil and the Sea

The contractor is in somewhat the same position as the man between the devil and the deep blue sea. He cannot regulate the prices of his materials, the manufacturers do that and look after "No. 1" in doing so. He cannot regulate the wages, for the unions do that and also recognize "No. 1" first, foremost, and all the time. Where then can the contractor start in his effort to obtain greater efficiency? Eliminate duplication of **work** and start in by insisting on the engineers and architects supplying a bill of quantities together with the plans and specifications for the work. Refuse to do the other man's job, (which is duplicated by every contractor figuring on the work), thereby reducing your own over-head costs and saving the owner a very large additional cost to his building. It was pointed out in these columns some time ago that the cost of estimating a certain job (each contractor taking off his own quantities) was actually in excess of the actual contract, which was something over a \$20,000 proposition.

The manufacturers are organized, and labor is organized. The contractor is between the two and surely needs protection, and if the recently formed association would only get busy along these lines it would be doing some good not only for the contractors but for all concerned. It is joint action by the contractors which is necessary, for the quantity survey has to come and is necessary for lump sum, percentage, or cost plus fixed sum basis of contracts.

Obtain greater efficiency by having an expert take off the bill of quantities **once**, instead of every contractor for himself. Obtain greater efficiency by co-operation between the contractors, engineers and architects, as was pointed out by the writer in an article which appeared in the March 19th issue of the "Contract Record."

It is to be hoped that some of our English quantity surveyors will notice this article, and get busy along the lines of which they are expert. The writer would be glad to help anyone to make a success of quantity surveying, and would give them a hearty welcome into the field of the contracting profession.

[A movement in the direction indicated in the above article has been made in Montreal, as shown by an item appearing in the "Contract Record" of June 18, page 577.—Ed.]

Wherein the Ontario Lien Law Needs Revision

A Committee of the Provincial Exchange States Its Views
on the Defects of the Act and Suggests New Provisions

Editor, Contract Record:

IN reference to the Mechanics' and Wage Earners' Lien Act about which you have spoken from time to time, the following information may be useful.

Our committee would be glad to hear from any of your readers who have opinions to express.

Mr. Joseph Russell, M.P.P., in presenting amendments to the Lien Act, as quoted in your issue of April 16th, 1919, was advised by the Hon. T. W. McGarry, that a commission would be appointed by the Government to draft an entire new Act, and as the Provincial Builders' and Supply Association has had this subject up for discussion for the last two years, we are pleased to take advantage of your generous offer to state our view points through your columns.

Many Interests to Consider

In discussing this matter we found many obstacles in the way of effecting the object we desire and that every scheme suggested resulted in complications of what we considered a hardship on some interested party. We have to consider the general contractors, the workmen, the supply firms, the architects, the owners, and the loan companies.

When a deputation from our association waited on the Hon. Mr. Lucas, we pointed out what we thought were faults in the present Act. Our objections were roughly as follows:

1st. The Act does not give the sub-contractor and supply firms the same privilege to lien as it gives the principal contractor. The Act reads "in the case of a contract which is under the supervision of an architect, engineer, or other person on whose certificates payments are to be made, the contractor may file a lien within seven (7) days from the date of the is-

suing of, or the refusal to issue, a final certificate." The sub-contractors' and supply firms' right to lien expires thirty (30) days after the completion or abandonment of the contract. This clause refers to an amendment put through Parliament by Wm. Hill, ex-M.P.P., about 1885. Mr. Hill is past president of the Builders' Exchange, and his amendment has proven to be of great value to the contractors, but of late years it has become the custom to bulk contracts, and in so doing the sub-contractor sometimes feels it a hardship, in cases where the general contractor fails.

2nd. The Act allows the owner to mortgage material and labor he has not paid for. We pointed out that it is the custom of the loan companies to issue building loans, taking a mortgage for 50 to 60 per cent. of the value of the land and buildings, and advancing money as the work progresses, thus enabling an unscrupulous owner and builder to get his buildings as far advanced as his creditors will allow, and make a substantial draw and refuse to pay his creditors. The money left in the hands of the lenders is very seldom more than enough to complete the work, making all liens valueless.

3rd. The Act does not cover the value of material that is specially manufactured for a building, and is not delivered on or adjacent to the premises. This very often entails a loss in cases of the stone-cutter millmen and others who have manufactured articles made to special detail and are unable to deliver them on the premises until such time as the building is ready for their installation, thus leaving material that is of little value on the manufacturers' hands.

4th. The Act says in no case is the owner liable

for more than the full amount of the original contract price. This clause is often taken advantage of by owners entering into an agreement with others to build at a price they know to be inadequate, and by so doing they both profit at the expense of innocent creditors. In other cases the architect and owner knew or ought to have known that the contract price was so low that the contractor, (unless financially strong), would fail, and the owner would gain at the expense of the general contractor's creditors.

5th. The Act defines the owner as one who owns the property at the time the contract is entered into to build, and in case the owner sells the land and building before the time for liens has expired the purchaser is not liable for any debts, accrued to his time of purchase. It is a practice of the speculative builder to sell his buildings before completion and in a recent case tried in Toronto, where a building was sold and the time had not expired for filing liens, the trial judge held that the liens were not registered prior to the time of sale, the purchaser was not liable and all claims were valueless.

Speculative Buildings Not Covered

We have carefully examined several of the U. S. state Acts, together with some of the Provincial Acts, and are of the opinion that not one of them would fully cover speculative buildings. The speculative builder is the owner, the contractor and the architect, and these cases are what the supply associations are anxious to cover.

The loan companies object to any Act that will give liens priority over mortgage. The general contractor is fairly well satisfied with the present Act, and no doubt will object to any changes that will necessitate a lot of red tape; some of them have expressed their willingness to adopt a 100 per cent. law similar to the Michigan State Act. The owner and architect are protected against liabilities of contractors through sworn statements, giving the amount due or to become due, to such sub-contractors and persons for work done and material furnished. The sub-contractors would like the Act to go far enough to protect them on all government and municipal contracts. At present they have to depend entirely on the government or municipal authorities holding enough money to satisfy their claims.

Thanking you for the interest you are taking on behalf of the Provincial Builders' and Supply Association, we remain,

Yours truly

Legal Committee, Provincial Exchange.
Toronto, June 18th, 1919.

Operation of Brick Plants on Less Than a Ten-Hour Day Will Mean Increase in Prices

By F. B. McFarren*

THE large amount of very necessary housing work which is in progress at the present time has caused a greatly increased demand for bricks. As the investors are beginning to realize that there is little likelihood of any reduction in the cost of materials, some of the larger work is starting. In view of the facts that fuel at the mines or shipping points costs about two and one-half times what it cost in 1913, that labor costs double and freight

charges to the import centres are 50 to 100 per cent. larger than in 1913, and the selling price of brick at the brick plants is only from 20 per cent. to 25 per cent. greater than in 1913, this is conclusive evidence that only those plants operating very efficiently can operate at a profit with selling prices as they are at the present.

Practically all brick plants operate ten hours a day, and if any legislation is enacted to reduce operating time, the price will have to be materially increased, as the lower production per day from a given amount at plant means that to produce the same amount of material daily, the amount of plant and the number of kilns will have to be increased and as brick machinery and kilns depreciate very rapidly and the present cost is approximately double the pre-war cost, an eight-hour day would mean an increase in the present price of brick of approximately \$5.00 per thousand. Brick manufacturers, however, who have operated their plants during the past five years, have endeavored to work out satisfactory arrangements with their employees, either by production bonuses of piece work operation so as to give their employees an adequate return for efficient workmanship, and there is very little discontent in this industry so far noticeable, and it is a question whether the men desire shorter hours.

At our own plant, we have erected a number of cottages during the past year so as to give our men better housing accommodations. While the financial return from this investment is not attractive, the satisfaction to the employees more than repays any loss from renting these cottages at a low rate.

There does not seem to be any good reason why the building industry should not now improve, and the writer looks forward to a most prosperous condition in this industry for some years to come.

Costs can be Kept Down by Avoiding Rush Jobs and by Taking Time to Prepare Proper Plans

By E. A. Wallberg, C.E.*

THE normal cost of large construction work will be materially reduced in my opinion for two or three years after which time there will be a gradual reduction. The best suggestion that I can make for reducing the cost of work is to avoid the rush feature. Sufficient time should be allowed for thoroughly considering and completing the plans and specifications before beginning any construction. Also by having sufficient time to carry out in a normal way before beginning the permanent construction, all preliminary work and general facilities such as railroad extensions and sidings, general road improvements, power lines, water service, housing facilities and the procurement and installation of complete plant and equipment, the cost of this preliminary work, and particularly the cost of the permanent work which constitutes the main feature, can generally be reduced as compared with the cost of rush construction much more than by all the petty economies that can be effected.

This suggestion applies most forcibly to large work, such as Hydro-electric power plants and mills and other large industrial constructions. Similarly smaller economies can be effected in ordinary city work if this work can be carried on in a normal way from plans fully matured before beginning construction and without special rush.

*Manager Interprovincial Brick Company, Toronto.

*Engineer and contractor, Toronto.

New Conception of Efficiency is Not Maximum Production but Maximum Happiness

Competitive Capitalism Under Fire Because of Its Materialism, Heartlessness, and Wholesale Waste

By Andrew Glen*

MUCH has been written about efficiency in business and industry. Our experts have planned elaborate systems co-ordinating the innumerable functions indispensable to our colossal, modern plants; they have ordered the minutes of an individual's business life and directed his every movement. What was behind it all? Simply mechanical efficiency. They have been trying to produce machines to give 100 per cent. efficiency—machines which would deliver the same amount of energy, in work done, as was put into them. We have seen plants running with perfect regularity, little friction, little waste, no overlapping, giving highest return for money invested. Plant efficiency of 90, perhaps 98 per cent. This is the goal of our experts. Consider the whole world organized on these lines. Would we then have maximum world efficiency? Would we then have reached the zenith of man's attainment? By no means. Our craze for this particular kind of efficiency has already brought the world within an ace of destruction, we have been concerned only with the mechanical efficiency, not the ultimate human efficiency. The new conception of efficiency which necessity is thrusting upon us, demands, not a maximum of human production and profits, but a maximum of human happiness.

This is the great question of the day and one which is now translated from the realm of the dreamer and the visionary to become a practical issue of the first magnitude.

One hundred and one things, from spots on the sun to prohibition are given as reasons for the world's unrest, according to the shallowness of our thinking or the extent of our ignorance, and the light remark usually follows, "Oh, it will soon be all right, things will settle down before long." But as practical men we must face the issue squarely for it is nothing less than the approaching breakdown of our entire industrial machinery.

Capitalism Under Fire

The system known as capitalism in which industrialism has developed so rapidly, is under fire from many quarters. Economists and writers are exposing foundations and labor is massing its battalions for the attack. How long will it withstand this united assault?

Let us examine the question from the standpoint of some of the assailants. The ordinary working man is chiefly concerned about his immediate wants. Given a fair standard of living and a steady job he does not complain. Unfortunately, under the present system permanent employment cannot be guaranteed nor the standard of living kept at a constant level. Without considering such things as over-consumption, and competitive markets, the workman who is let out of his job accepts the blow as inevitable and he and his family go short till things pick up again. But the education of the average worker is constantly on the up grade and collateral with this advance comes the de-

mand for a higher standard of living. To secure these demands we have seen the initially slow but accelerating growth of the trade union movement. Labor is now so well organized that it cannot be ignored with impunity. It has naturally shared in the general enlightenment due to the war and consequently its demands are now heavy and embody, part control of industry, a larger share in the fruits thereof and steady employment. This is an indirect attack upon the system which finds it increasingly difficult to meet these demands and make profits.

Socialists' Point of View

Among the workers there is an ever growing body which is not prepared to accept bad conditions as inevitable. The socialists having studied the system from all angles condemn it vigorously. They are the brains of the labor movement and become its leaders. Their contention is that the workers produce all wealth. Land, forests, natural resources should be the common property of the people and all wealth produced, should be for the common good. Profit they say is only the "surplus value," of any article produced, over and above the actual cost and is wrongly acquired by an individual or corporation having private ownership of the means to produce the article.

Professor Scott Nearing gives this illustration of the point, saying to an employer.

"What right had you to tell that man to hurry just now?"

"I pay him to hurry."

"What do you pay him?"

"Three dollars a day."

"Where do you get the money to pay him with?"

"I sell bricks."

"Who makes the bricks?"

"He does."

"How many bricks does he make?"

"Three thousand a day."

"Then instead of your paying him, he pays you for standing around and telling him to hurry."

"Well, but I own the machines."

"How did you get the machines?"

"Sold bricks and bought them."

"Who made the bricks?"

"Shut up, you fool, he might hear you."

The socialist points, to the phenomenal increase in production due to machinery, specialization and organization and pertinently asks why the workers who now produce individually 10, 100 or 1,000 times more than formerly should have to be content with a bare subsistence. But the socialist never asks for reforms arguing that they but postpone the day when a majority will favor a complete change.

Cannot Convince Bolshevik; Only Knock Him Down

Socialists for the most part are pacifists believing that the justice of their cause will in time work out the solution. When one stoops to lower methods the brand of the Bolshevik is placed upon his brow. The

*Manager, John T. Hepburn, Ltd., Toronto.

development of Bolshevism in Russia, however, was due to the logic of events rather than the desire to use force. Soon after the Bolsheviks got control of the government, they were put on the defensive by the attacks of various small groups of opponents. Outside aid was given to the counter-revolutionaries and to combat the growing effort to overthrow it, the government was compelled to organize its red army. Thus Russia, standing alone for a communistic system, soon found herself in a virtual state of war with all the capitalistic countries of the world and realized she had to fight for her life. With an enthusiasm born of sudden freedom from a great oppression, Russia commenced her Holy War to be waged throughout the world. Hence the wild Bolshevik, as fearless, as fiery, preaches his doctrine in whatever country he may happen to be. What are we to do with him? He can debate his theories; he can stand on principle. Tell him his methods of force and violence are all wrong and he will cynically remind you of the universal application of force during the last five years for ideals, some good, some questionable. You cannot convince him; you can only knock him down. But in spite of repression of every kind they multiply and are destined to be, perhaps the greatest international factor in changing the social order.

The apologists for our present system should remember that nothing is permanent. In the evolution of the human race many systems and phases of civilization have served their purpose and been scrapped. No one but a fool would imagine that capitalism is the final phase and must remain for ever. It is only one step in the march of progress.

Capitalism in itself is heartless. It is an organism, materialistic and relentless. It produces dividends and destitution; profits and poverty; it makes Sultans of some and slaves of others; it creates wealth and causes wars. Because it is partial it is unjust. Being unjust it hinders progress and therefore stands con-

demned on moral grounds. A great moral wave is sweeping the world to-day and capitalism is one of the institutions which will be compelled to justify its existence or be superseded.

Wholesale Waste

Economists to-day are general in their denunciation of capitalism. They see a system in universal operation which if it were applied to an individual business would soon wreck it. There is wholesale waste. Innumerable little firms are struggling to exist in the same line. New ones spring up, not to supply a demand but to compete with those already able to cope with it. There is tremendous duplication and a non-producing force of travellers is maintained to contend for orders. Competitive advertising is wasteful. There is feverish production when the supply is low and then a periodical slump, and failures. Regulation of supply is undesirable because production is for profit not for use. The struggles for survival compels organization in larger and larger groups. These hold the small firms which remain, in virtual subjection. The men we find behind the larger groups are not captains of industry and nation-builders but company promoters and financial magnates whose chief concern is to procure "six per cent. or better" to enable stockholders to live without performing social service. To support drones is economic waste. Consider too the effect of men having to sell their labor as a commodity. There is a wealth of energy untapped because they must sell their labor as cheaply as possible. Hence the consequent curtailment of output; the constant bargaining; and the most damning indictment of the whole system—the incessant strike interruptions. The competitive system of capitalism is a colossal failure. It is wasteful and inefficient from beginning to end, far outweighing any incentive value it possess. Co-operation, where all would benefit, would provide greater incentive and more real progress would be made. A great field still lies ahead of our efficiency experts.

The Cement Gun and Its Product "Gunite"

Has Advantages In Keeping Costs at a Minimum—An Inexpensive Process Adapted to a Variety of Work

By R. Ewart Cleaton, A.M. Am. Soc. M.E.*

WITH the cost of materials showing very little sign of decreasing, and the cost of labor decidedly the reverse, not only engineers and architects, but also contractors, are casting about for means of obtaining cheaper construction. The product of the cement gun, now familiarly known as "gunite," is receiving a great deal of attention in this respect, due to the satisfactory results that have been obtained from it during the last few years.

Although the aggregates of "gunite" and hand-applied cement mortar are the same, viz.: sand and cement, the characteristics of the finished product differ widely and are greatly in favor of the former. The two chief reasons are that "gunite" is hydrated at the nozzle, and therefore only as the material is being shot into place, thus obtaining the benefit of the whole of the initial set, and secondly, the material being applied by air pressure ranging from 35 to 50 lbs. per square inch, is much denser and enters into

every pore of the surface to which it is applied, thus securing a far better bond.

Fire-Proof and Water-Proof

Exhaustive tests have absolutely proven that "gunite" of a thickness of 1 in. is not only fire-proof but water-proof, neither of which of course can be claimed for the same thickness, or even double the thickness of hand-applied mortar. Tests made at Washington, D.C., by the Bureau of Standards and at the Lehigh University by Professor Frank P. McKibben, have established the fact that the relative strengths of "gunite" and hand-applied mortars or concrete are as follows:

	"Gunite" (average of samples)	Hand placed 1: 2 mortar
Compressive strength lbs. sq. in.	4,145	2,184
Modulus of Elasticity lbs. sq. in.	4,278,000	1,538,000
Tensile strength lbs. sq. in.	690	142

Besides its intrinsic merits, "gunite" possesses the additional advantage of very materially reducing the

costs for labor on the work on which it is used. For example, on wall work, practically no form work is required, thus making it possible to dispense with carpenters and eliminate the heavy cost of lumber for the forms. An example of this class of work is the large machine shop recently built by the Traylor Engineering and Manufacturing Company at Allentown, Pa. Over a framework of steel "gunite" was shot on 2 in. mesh, No. 16 gauge expanded metal. The panels were designed of uniform size, and the only forms required were three removable ones which were used alternately, and moved ahead of each other as the work proceeded. The thickness of the walls is 2 in., and the total cost, exclusive of air, but including the expanded metal, was 17¾c per square foot.

An Inexpensive Process

This is practically the most expensive type of construction on which "gunite" can be used. A much cheaper form has been adopted by the Ontario Hydro-Electric Commission in connection with the various construction camp buildings on the Chippawa Creek development. In this case the majority of the buildings are of wood; tar-paper and poultry wire of 2 in. mesh, and No. 15 gauge were attached, and over this a 1 in. coating of "gunite" applied. The most recent building erected on this job has merely a wooden framework, to which the tar-paper and reinforcement are nailed and the "gunite" shot over. All these buildings have been proven weather-proof, the latter being used as a cement store, and are fire-proof from the outside.

Other uses to which the cement gun is being put are innumerable, but a few of them are as follows:

Fireproofing of Steelwork.—"Gunite" was specified for this purpose on the new Parliament buildings at

Ottawa, and the Union Station at Toronto. Also at the new paper mill now being built for the Kipawa Co. Ltd., at Temiskaming, Que.

Coke Oven Repairs.—The cement gun was used by the Wilputte Coke Oven Corporation at the Hamilton plant of the Steel Company of Canada, Ltd., for filling in the pre-heating cracks, and is used by them on all their jobs.

Stucco Work.—"Gunite" is specified on several hundred houses being built by the Halifax Relief Commission, the upper part of these houses being covered with "gunite."

Shipbuilding and Lining.—A number of barges have been built for use on the New York State barge canal, and others for the Standard Oil Company, the principle adopted being to use precast ribs and "gunite" sides, decks and bulkheads.

Lining Steel Smoke Stacks and Acid Tanks.—Remarkable results have been obtained on work of this nature, the "gunite" successfully resisting gases of combustion, and dilute sulphuric, as well as strong nitric acid.

Repairs to Masonry and Coating of Dabs.—A typical example of the former is the coating of the piers of the Grand Trunk Railway bridge at Weston, Ont.

Mine Work.—Fire-proofing of timbers and building of stops has been carried out in the mines of the Acadia and Dominion Coal Companies in Nova Scotia.

The ease and cheapness with which it can be operated is rapidly causing it to be looked upon as a standard part of their equipment by the more up-to-date contractors, whilst the superior qualities of "gunite" are appealing more and more every day to engineers and architects, as it becomes more widely known.

Scientific Management in Road Construction

A System of Cost-Keeping for Highway Work Secures
Greatest Possible Performance for a Given Outlay

By A. W. Campbell*

IN the industrial world the practice of cost-keeping, recently developed, has added a new interest as well as increased profits to business. A manufacturer of furniture, for example, who does not know, let us say, what it costs to turn or varnish the rung of an oak chair, is not up-to-date, and is missing a great deal. The manufacturer who has installed a cost-keeping system in connection with his factory or plant, receives daily, weekly and monthly reports on the preparation and disposition of the materials being used and the efficiency of the labor employed. He may know, therefore, the cost of any operation in his factory or plant. The success of his business will depend in great measure on how carefully he studies his reports and investigates the particular causes of unexpected results. Mechanical time-recording devices take the place, in business, of what is known as a time-keeper on construction work. What industrial cost-keeping has meant to the manufacturer, highway cost-keeping bids fair to become in connection with construction work on highways. The highway contractor or engineer who is at all familiar with the subject will find he owes it to himself to make use of the data

supplied by, and stimulus to morale resulting from, a properly kept highway cost-keeping system.

Highway cost-keeping is an attempt to apply the principles of scientific management to road construction. The science of management is itself of comparatively modern origin. In the engineering world its James Watt is Mr. Frederick W. Taylor, the past president of the American Society of Mechanical Engineers. Mr. Taylor laid stress on the importance of the law of regular cost unit reports of performance or production, when formulating certain fundamental laws of management. Highway cost-keeping has, therefore, been evolved by engineers to produce increased efficiency and to gauge costs in connection with engineering work. It aims at the determining of the number of units of work or materials, or both, entering into a given operation connected with road work.

It is almost impossible, in Canada, to secure to-day reliable information as to cost of materials and labor entering into a certain type of highway construction. The difference in estimates given in the different provinces of the cost of constructing gravel roads is a case in point. Hence, responsible administrative offi-

*Dominion Highway Commissioner.

base future estimates there are many general advantages worthy of consideration. There is the increased interest created among the men and the foremen. They know that the contractor or engineer knows just what they and the next gang are doing. Friendly rivalry between the gangs leads to better team work and an increased esprit de corps is created. Secondly, an engineer need not give his attention to those sections of a work of construction where the records show results are above the average; he will confide himself to those sections where he is needed. Consequently, an engineer can direct a larger force more effectively than where there is no cost-keeping system. Efficiency has been defined as the elimination of needless motion; it is therefore evident that highway cost-keeping tends to increase efficiency in this connection alone. Again, any practice that encourages the ambitious man to do his best is a distinct gain. Having the foremen's performance on record provides an incentive that reacts on all the employees engaged.

If a provincial highway department establishes a highway cost-keeping service, the forms used by it should be provided to any contractor who may desire them, thereby facilitating his keeping the data in a form that will be uniform throughout the province. The units used in any case must be agreed upon between the contractor, engineer or foreman who makes the measurements and the time-keeper, cost-keeping clerk, or foreman, who makes the adjustments. All that is then required is a cost data book in which each contract is sub-divided into various items, such as excavation, rock crushing, grading, base construction, etc. Labor and materials are charged under their headings in separate columns so that any time the cost to date of either or both may be ascertained. It is highly desirable where a province is granting aid to its several municipalities for road construction, that a condition of such aid be that each county require every contractor on provincial aided road work to file a certified copy of his pay roll monthly and upon completion of the work, a sworn statement, accompanied by vouchers, showing the cost of all labor and materials used, and the net profit on the work, with the county engineer. The county engineer should then make an abstract of this data and submit it to the Provincial highway department. It would also be very desirable to have such data with respect to maintenance of provincial aided work, as the department would be able to determine, after a number of years, which type of pavement, having regard to its initial cost, the traffic it is required to sustain and its wearing life, is most economical.

While the primary purposes of highway cost-keeping are to secure the greatest possible performance for a given outlay and to secure data upon which to

EVERY contractor doubtless has considerable trouble keeping a record of his tools, particularly if he executes a number of what may be called medium-sized jobs. The suggested tool record shown herewith will be found to save some time if a contractor deems it worth while keeping a record or itemized list of any description, as by this method of ruling it saves re-writing the names of the tools and it also shows at a glance where all the picks or shovels might be at any particular date.

Every contractor has no doubt gone through the experience many times of starting a new contract and wondering where all his small tools could possibly be and why it is that he is always buying tools. A book ruled somewhat similarly to the specimen page given herewith can be secured for about \$1.50 and by cutting the pages with a vertical line at the end of the space marked "name of tool," room can be made for any number of jobs without again listing the tools.

The writer would suggest that, when a contract has been completed and all the tools either accounted for or charged up if lost, a red ink line should be ruled diagonally across the columns belonging to that job as in the accompanying illustration of "R. F. Jones House." This will save looking down or across those particular columns when trying to locate some tool. Columns are naturally required to

Name of tool	F.R. JONES		HOUSE		WILKINS		BAKERY		UNEEDA BISCUIT FACTORY		REMARKS	
	Delivered No	Date	Removed No	Date	Delivered No	Date	Removed No	Date	Delivered No	Date		Removed No	Date
Adze	1	5/29/19	1	5/29/19	1	5/29/19	1	6/5/19	1	6/5/19		
Picks	4	5/29/19	4	5/29/19					4	5/29/19		
Saw cross cut	1	5/29/19	1	5/29/19					1	5/29/19		
Shovels round mouth	7	5/29/19	5	7/6/19	5	7/6/19			2	7/8/19		
" square "	8	5/29/19	7	7/8/19	1	7/6/19			7	7/8/19		
Wheelbarrow	6	5/29/19	2	6/5/19					2	6/5/19		
Branches, Rope			4	6/8/19	4	6/8/19						

keep a record of the yard and these can be readily inserted on the pages.

Gasoline and Electric Hoisting Equipment Spells Efficiency to the Contractor

THE progressive engineer or contractor is always alert to see and grasp new ideas, and ever on the look-out for improvements in either machinery or methods by which he will be enabled to get his work done more quickly and at a lower cost. Speed is usually an important item in every contract, but the first consideration in the mind and plans of the builder or contractor is the profit he expects to make on the job. Hence anything that will increase his profit by speeding up the operations of his men and increasing their efficiency is not only of interest to him, but is just what he is looking for.

So it is to be expected that the men in charge of the large building operations in this country have not been slow to take advantage of the advent and development of electric and gasoline power to aid them in their building operations.

It is not so very many years ago that practically the only machinery used in construction work was operated by either hand power or by horse power. In fact the hand power lifting machines are still in use in all sections of the country, and will probably never go out of date for handling the lighter building materials. But the old horse power machine for operating a derrick is practically obsolete in building operations, it is still to be found at work in quarries and in some of the smaller mines.

The steam driven hoists were warmly welcomed

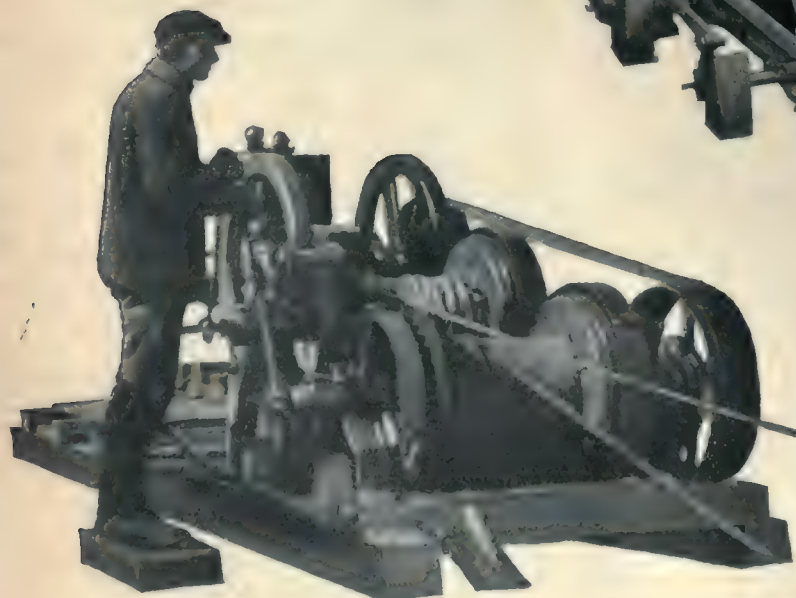
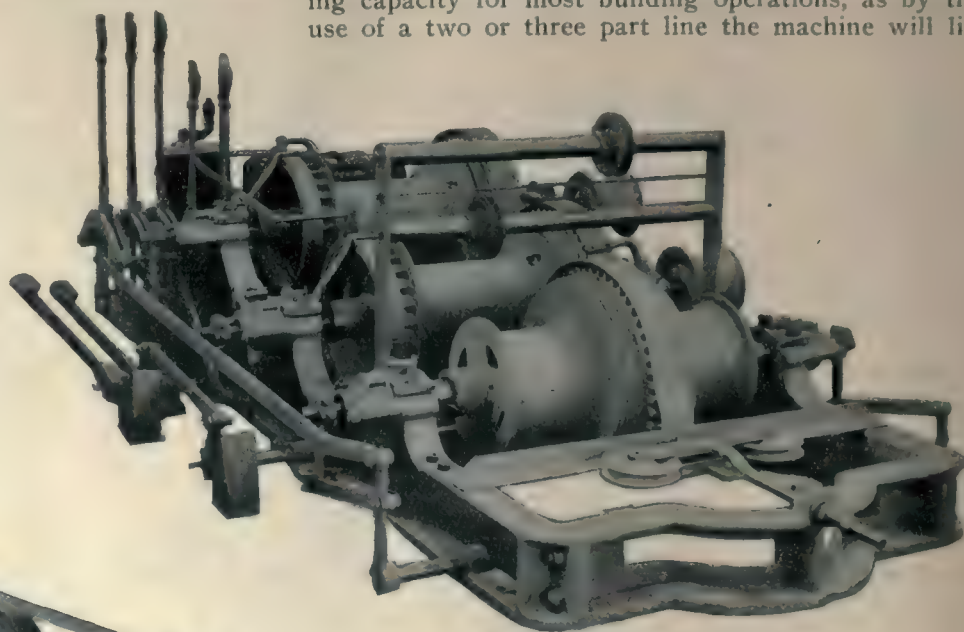
by the building fraternity because heavier materials could not be handled, and all the building operations speeded up owing to the more rapid moving of materials of all sorts. Many special machines and devices were gradually developed, such as the large sheave for operating a platform elevator from an endless rope, the independent spool or 'niggerhead', as it is frequently termed in builders' parlance, for hauling or lifting timbers, steel, etc. These improvements were speedily seized by the contractors, and soon became practice.

But the steam power has disadvantages. The boiler is heavy, and when attached to the hoist makes the machine rather difficult to move around, as has to be done so often. But a still more serious objection is the fire risk. Steam power cannot be operated without fire, and fire is undesirable about a building in course of construction, with its great assemblage of inflammable materials. Consequently gasoline and electric power hoisting machinery has been developed of late years, and has been used to some extent by some of the larger contractors, but has not as yet come into as general use as its merit deserves. It is probable that owing to the war and its benumbing effect on construction work in general the recent development of the gasoline and electric driven hoists has passed unnoticed by many builders and contractors.

The illustration herewith shows one of the smaller sized belt driven hoists run by a single cylinder gasoline engine operating a derrick. This machine worked this derrick all last winter, and ran perfectly satisfactorily, even at the lowest temperatures. This little hoist weighs only about 1500 pounds without the gasoline engine, and will lift 2600 pounds, or more than a ton and a quarter on a single line, which is ample lifting capacity for most building operations, as by the use of a two or three part line the machine will lift

On Right: An electric driven, two-drum derrick hoist

Below: Hoist belt driven from a single cylinder gasoline engine



two or three times as much, or two and a half tons and three quarter tons respectively.

The makers of these gasoline hoists are prepared to supply any size or type of hoist arranged for either belt drive or for direct gear drive off the engine. In other words, any of the ordinary sizes of builders' or contractors' hoists from 10 to 50 horse power may be had with gasoline drive, and supplied with either one, two, three or more drums, and with geared boom swinger. The special devices, such as large sheave, independent spools, etc., mentioned above, may also

be obtained as an integral part of one of these gasoline hoists of any size.

Electric power has also been used, where available, for the operation of hoisting machinery. The accompanying illustration shows a standard type two drum derrick hoist, with geared boom swinger, operated by an electric motor mounted permanently on the rear bed plate of the hoist. This is an extremely handy type of hoist that deserves to come into much more general use than it has so far, for to date its use has been restricted almost entirely to some of the very largest contracts, such as government buildings, wharves, etc. It is perhaps not generally known that these electric hoists may also be procured in any of the standard sizes or types, same as the steam or gasoline driven machines. That is, a contractor may procure a little ten horse power machine, same as described above, to lift a ton or a ton and a quarter on a single line, or the massive fifty horse power machine to lift six and a quarter tons on a single line or eighteen tons on a three part line, and still heavier loads according to the way he multiplies his tackle. Any size between these two extremes may also be obtained built for electric power, and any of them supplied with from one to four drums as may be needed for the job on hand. With these electric or gasoline hoists the contractor is able to move his machine about from job to job, or from place to place on the job very easily.

The illustrations used above were kindly loaned us by the Marsh Engineering Works, Limited, of Belleville, Ontario, who make the machines referred to in this article.

New Machinery Supply Firm

A machinery supply firm, under the name of Boynton and Williams, has recently been organized in Toronto to deal in machinery, mill supplies, contractors' equipment, pipe, valves and fittings, plumbers' supplies, etc. Mr. E. S. Boynton was formerly a pilot of the Royal Naval Air Service, being engaged in English coast defense and in raiding over Bulgaria and Turkey. Before enlistment he was sales manager of the Gidley Boat Company and for eight years previously had been connected with the Toronto branch of the Canadian Fairbanks-Morse Company, Limited. Mr. E. J. Williams has been engaged in the practice of steam and hydraulic engineering for the past twenty years, both in England and Canada. For the past nine years he has been connected with the Gurney Foundry Co. and the Standard Sanitary Co.

Revision of Building By-Laws Will Be Means of Contracting High Costs

(Continued from page 620)

Referring to item (4) I think this question has added more expense to the ordinary building than any other item in any building by-law, the question of live loads being more or less of an uncertainty. Numerous investigations have been made and it has been found that in a great many cases the live loads have been ridiculously high for such buildings as dwellings, apartment houses, hotels, office buildings, schools and other buildings of this nature, for it is self-evident that the ordinary office building will never get more than from 15 lb. to 20 lb. per square foot of live load, the only danger, of course, being heavy concentrated loads such as safes, or in the case of residences

or apartment houses, pianos, but when this is taken into consideration and beams figured for such loads I am confident that the live load can be greatly reduced and I am so recommending in the new building by-law which is now drafted.

New Book

"Concrete-Steel Construction (Part 1—Buildings)" by Henry T. Eddy, C.E., Ph.D., Sc.D., L.L.D. and C. A. P. Turner, C.E. The second edition rewritten and embodying the most advanced theoretical treatment is an analytical treatise of the stresses present in reinforced concrete as applied to building designs. The effort of the authors is to elucidate the harmony existing between correct theory and scientific practice and disclose the error of commonly accepted methods of computation. The development of elementary principles has been given close attention as a preliminary study for a more extended discussion of practical work and the more intricate and complex treatment of practical details. The authors point out the evil influence of the supposed inconsistency of theory and practice as opposing the development of the most desirable and economical designs. For example, in case of uncertainty as to the theoretical principles to be applied, the designer, for safety, employs material in such lavish manner as to render the cost of a fire-proof building prohibitive, when in fact incombustible material, such as reinforced concrete, scientifically designed may cost no more than the inflammable timber structure. The following chapter headings give an indication of the contents of this work: concrete; general types of concrete floor construction; mechanics of stress; mechanics of permanent deformation and strain beyond the limits of elasticity; the chemical and mechanical energy of hardening of Portland cement concrete and work performed by it; simple beams; restrained and continuous beams; indirect stresses generated by bond shear and their laws of distribution; deflection and mode of operation as shown by contour lines; distribution of reactions and moments as shown by lines of zero shear; the continuous uniform slab on separate supports under uniform loading; reinforced concrete columns; unbalanced moments in monolithic floors and columns; experimental verification of the theory of flexure of concrete members; foundations; elements of economic construction and cost of reinforced concrete work.

Mainly Constructional

East and West—From Coast to Coast

Permits for garages are being issued at the rate of ten per day in Toronto. To date there has been about 1,000 permits for garages issued in comparison with 1,238 for the entire year of 1918.

The government of Saskatchewan purchased a site with a frontage of 75 feet on Cornwall avenue, Regina, for the new provincial police headquarters. The building will be a two-storey structure with basement and will cost in the neighborhood of \$175,000.

A group of prominent building supply men of Winnipeg have applied for an injunction to restrain the Greater Winnipeg Water District from going into the sand and gravel business. The plaintiffs object to competing with municipal enterprises and claim the defendants have no legal authority to engage in the business contemplated.

The Imperial Tobacco Company of Canada have let the

contract for their new factory at Leamington, Ont. The site of the building is on Oak street. It will be a one-storey structure, 112 x 240 feet, built of reinforced concrete, with part basement. At the rear will be a power house 30 x 70 feet. Construction work is to be started at once.

The Toronto Housing Commission has purchased a whole block, bounded by Runnymede Road, Gilmour, Lincoln and Webb avenues, and the construction of seventy houses will be commenced at once. With no delays it is expected that these will be completed within three months time.

The Huron & Erie Trust Company will spend \$100,000 remodelling the old Cafe Royal, 18 King St. East, Toronto. The company intend fitting the building with a stone front, tiled floor and suitable modern equipment and will use the main floor for banking purposes. The upper part of the building will be fitted up for office use and let to special tenants.

Preliminary work on the Vancouver harbor improvements will be commenced at once. Mr. S. McClay, harbor commissioner, who recently returned from Ottawa where he has been conferring with Hon. C. C. Ballantyne, minister of marine and fisheries, expressed himself as confident that the \$5,000,000 government appropriation for harbor development would be voted very soon.

Construction work on the new warehouse for the Plymouth Cordage Company at Fort William, Ont., will commence soon. The building which will be a five-storey structure, 200 feet by 100 feet, will be situated on the left bank of the Kaministiquia river, and will be built of reinforced concrete with brick panels. The warehouse will have a storage capacity of 13,000,000 lbs. of binder twine.

At an open-air meeting at Thamesville, Ontario, recently, good roads advocates from neighboring townships as far east as London and as far west as Chatham were present for the purpose of discussing the route of the proposed provincial highway between London and Chatham. It was unanimously agreed that the Longwoods road would be the most satisfactory route and a resolution to this effect was adopted.

The Board of works of New Westminster, B. C., will shortly construct 198 feet of concrete sidewalk on Royal Ave. This is the first operation on a new plan adopted by the Board for the replacement of wooden sidewalks in bad condition with concrete walks. The city contributes the cost of constructing a wooden sidewalk and the property owners pay the difference between that and the cost of the concrete one.

The Dominion Oil Company have purchased the old Canning factory at Owen Sound, Ont., and will commence shortly to make the necessary alterations and repairs to accommodate the new business which will consist in the manufacture of oils, greases and soaps. The building purchased is 70 feet by 38 feet, three storeys high of stone construction. Sidings will be built into the property from the Grand Trunk Railway and large cement receptacles for holding tanks will be constructed.

The field work involved in surveys of the Sumas Lake reclamation project, in British Columbia, has now been completed and plans for the construction work are in the course of preparation. The scheme involves the erection of a pumping station equipped with 18 big pumps and an auxiliary station with 3 smaller pumps. The work is to be divided into three separate units with a separate contract for each unit. It is anticipated that the earthwork such as dykes and canals, will cost in the neighborhood of \$1,000,000. There will be another contract for concrete dams, pump houses, etc., and one for machinery.

The Toronto Housing Commission has made a promising start upon its program of 500 houses for 1919. One hundred houses are under construction; land has been obtained for 200 more and the commission has options upon sufficient other properties to permit the erection of the balance. The Commission reports that the first 100 houses are well under way and it is expected that the balance will be finished in part this Fall and those not ready for occupancy will be so far advanced that interior work can be carried on during the Winter.

Three hundred houses are now under construction throughout Ontario under the Housing Scheme, and it is stated that within another month 1,000 houses will be erected. Nineteen cities, 29 towns, 13 villages and 9 townships have adopted the housing plan. There are only four cities in the province that have not as yet taken advantage of Government assistance, namely, Kitchener, Belleville, Kingston and Peterboro. It is estimated by Government officials that about \$10,500,000 will be loaned to municipalities this year, of which the Dominion Government will furnish \$8,500,000. It is further estimated that next year, with all the commissions organized, the Dominion Government will be called upon to loan the municipalities \$15,000,000 for housing purposes.

Personals

Mr. R. J. Sandover-Sly has resigned his position as town engineer of Campbellton, N.B.

T. Carmichael, who was assistant to W. T. Mollard, Public Works Superintendent, Regina, Sask., has taken over Mr. Mollard's duties, the latter having resigned.

Major Gordon M. West, of the well known Toronto firm of architects, Molesworth, West & Secord, arrived home recently after two years of active service in France. Major West will shortly resume the practice of his profession.

Lieut. Raymond Stevenson, of Fredericton, N. B., who recently returned from overseas, has been appointed to a position on the Welland Canal engineering staff. Mr. Stevenson saw more than four years' service overseas with the Canadian Engineers.

Mr. Paul Domville who recently returned to Hamilton after two years' active service with the Royal Naval Canadian Volunteer Reserve, will associate himself with Gordon J. Hutton, architect. Mr. Domville served his apprenticeship with the firm of Mills & Hutton of this city, and received his architectural schooling at the Hamilton art school of the technical school.

Brig.-Gen. Charles Hamilton Mitchell, C.B., C.M.G., D.S.O., Great Britain; Officer de la Legion d'Honneur, France; Croix de Guerre, and Officer of the Order of Leopold, Belgium; and Croci di Guerre, and Officer of the Crown of Italy, Italy, whose brilliant record in France during the years of warfare, has reflected honor upon the Canadian engineering profession, and upon Canada itself, now returns to Toronto to use his talents in the pursuits of peace. As our readers will recall, Gen. Mitchell has been appointed Dean of the Faculty of Applied Science and Engineering of the University of Toronto and at the same time will retain his connection with the firm of C. H. and P. H. Mitchell. The engineers of Montreal, in honor of their distinguished confrere, held a banquet upon the occasion of his arrival in that city, and the Engineer's Club of Toronto, on his return home, tendered him a similar token of their respect.

Brodie's Limited, Montreal, have obtained a contract for the supply of granite blocks for paving for the city of Sherbrooke, P. Q.

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